THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXXI. No. 1811.] LONDON, JANUARY 25, 1898. [50TH YEAR. PRICE 6d.

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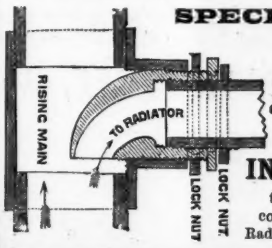

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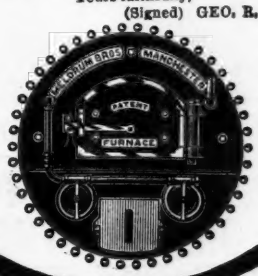

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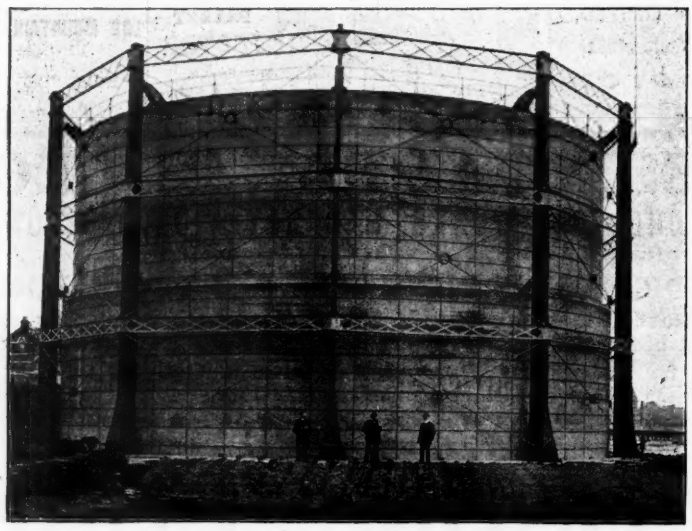

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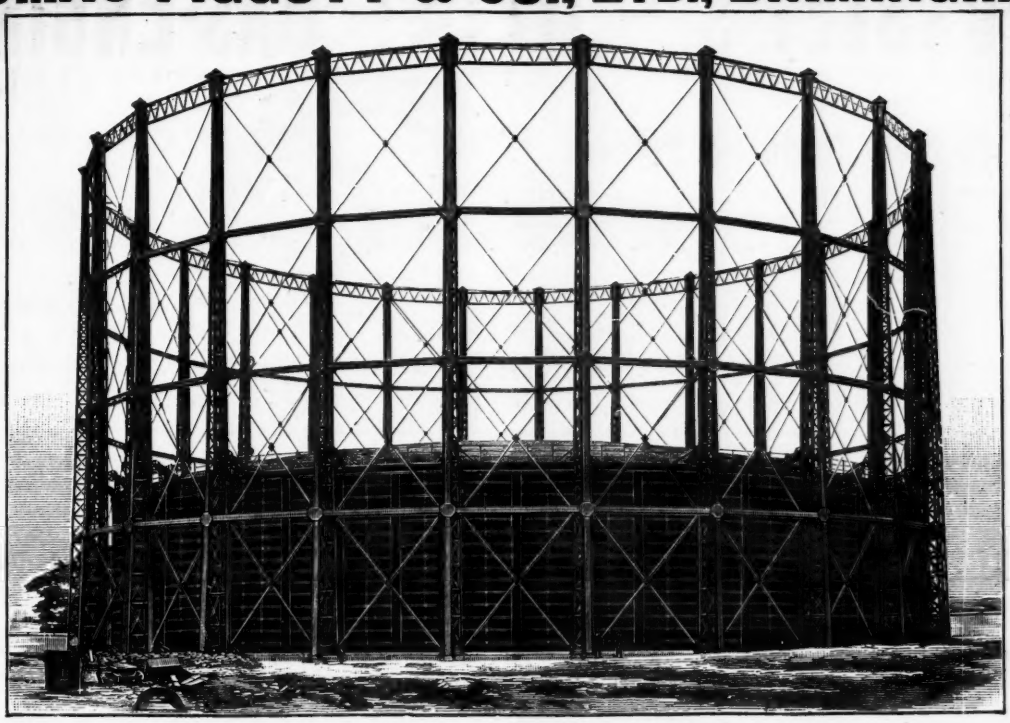

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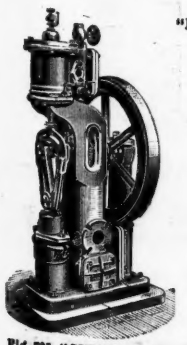

Fig. 703. "SINGLE RAM" STEAM-PUMP.

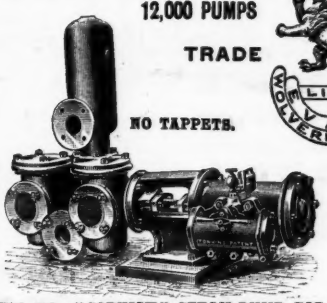

Fig. 598. "CORNISH" STEAM-PUMP FOR BOILER FEEDING, &c.

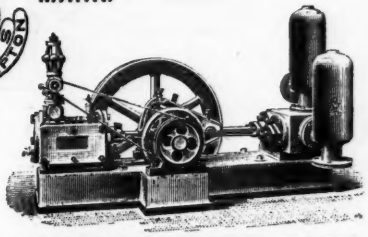

Fig. 688. "RELIABLE" STEAM-PUMP FOR TAR AND THICK FLUIDS.

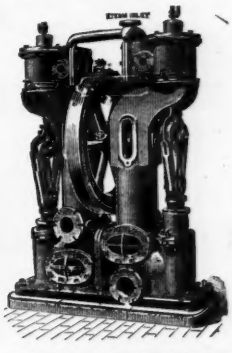

Fig. 712. "DOUBLE-RAM" STEAM-PUMP.

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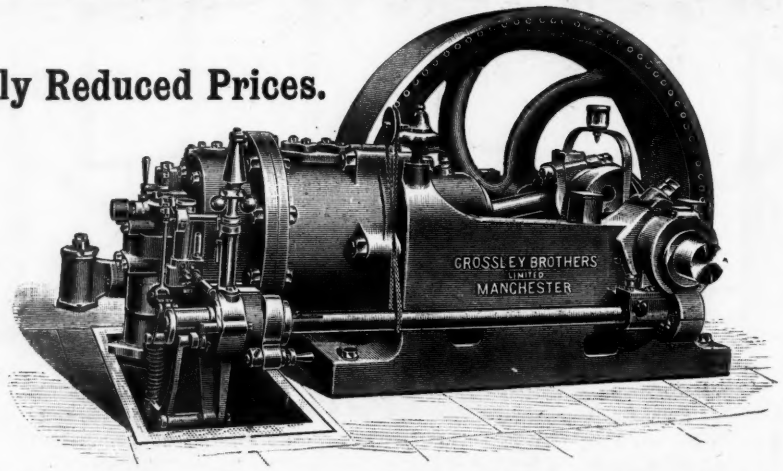

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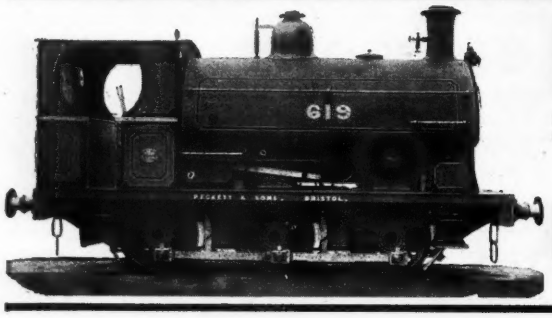

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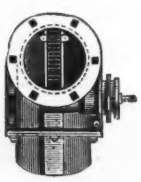

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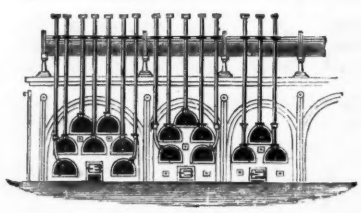

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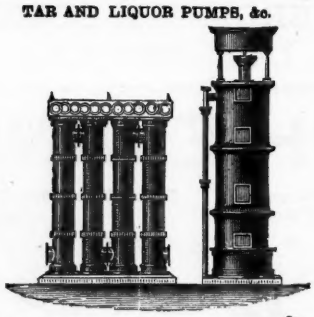

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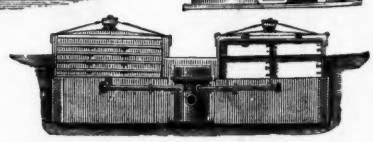

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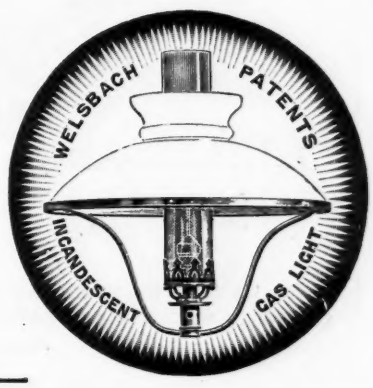

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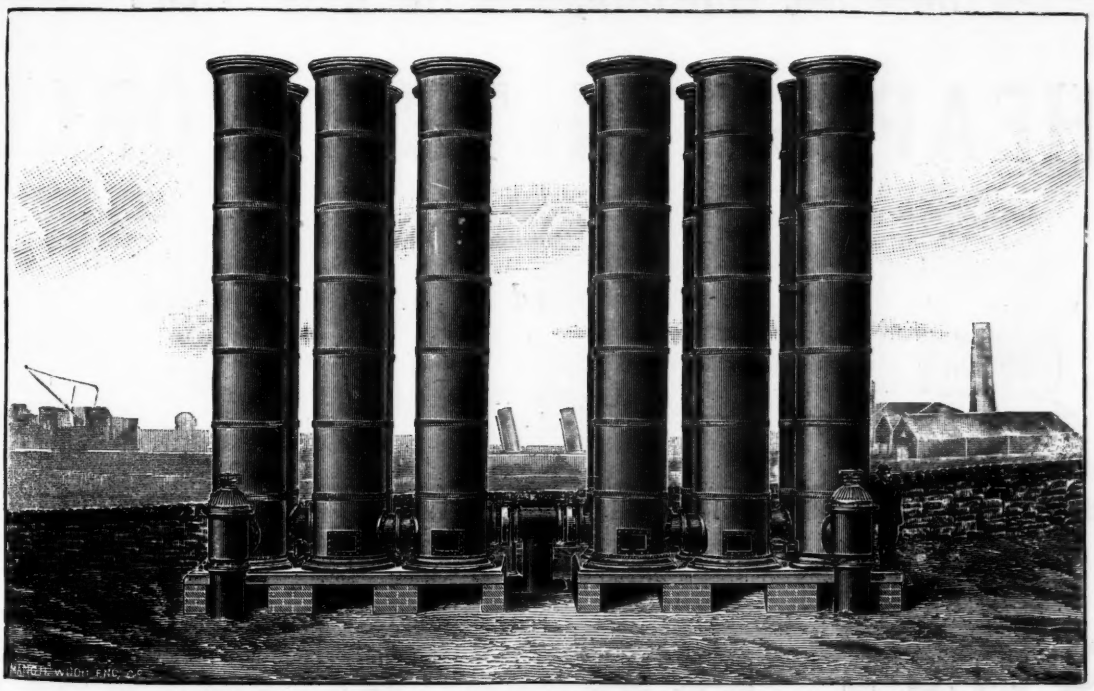

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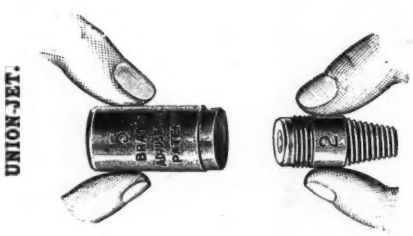

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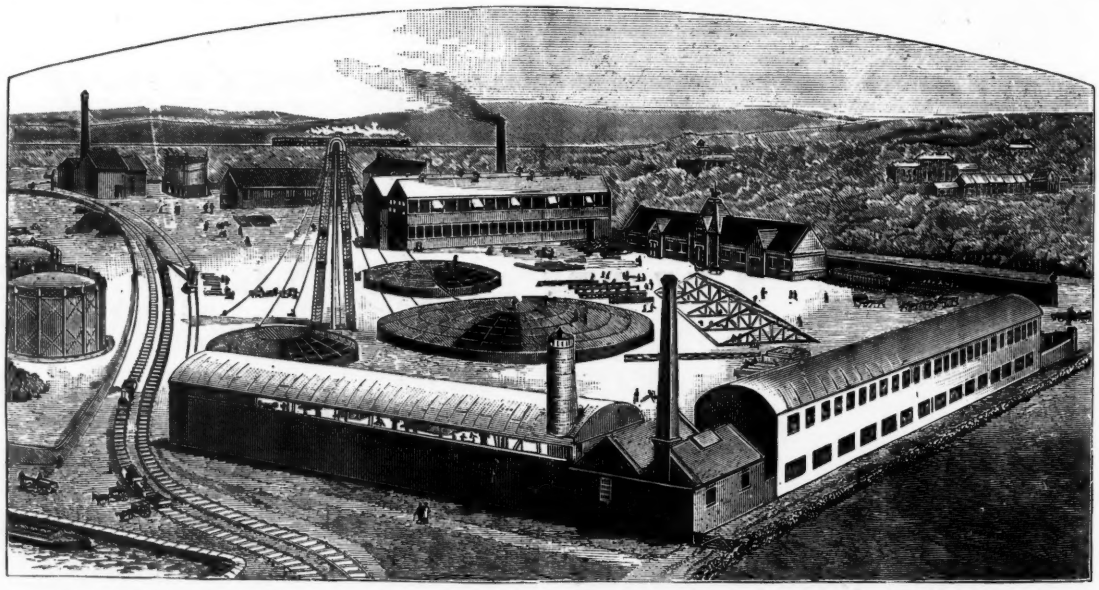

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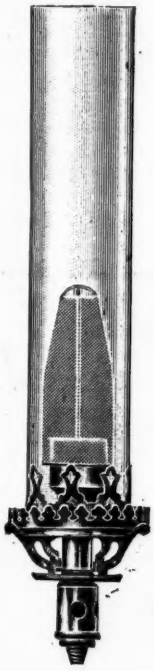

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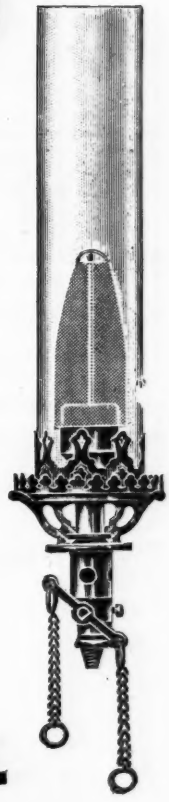

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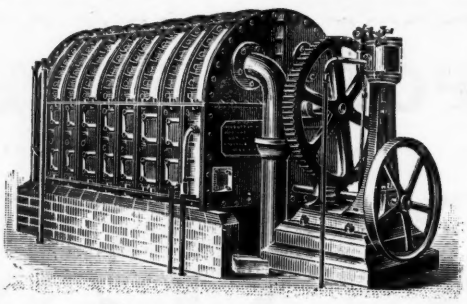

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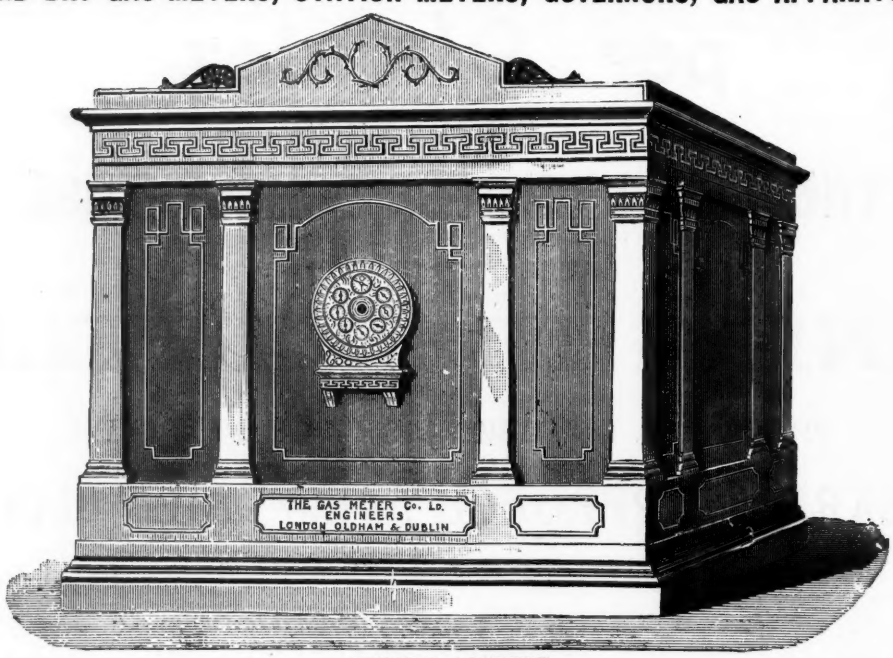

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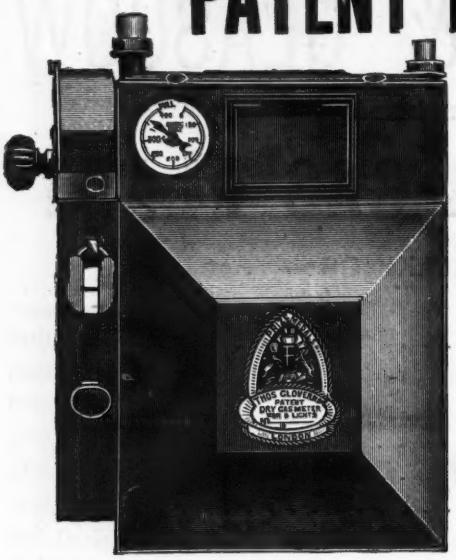

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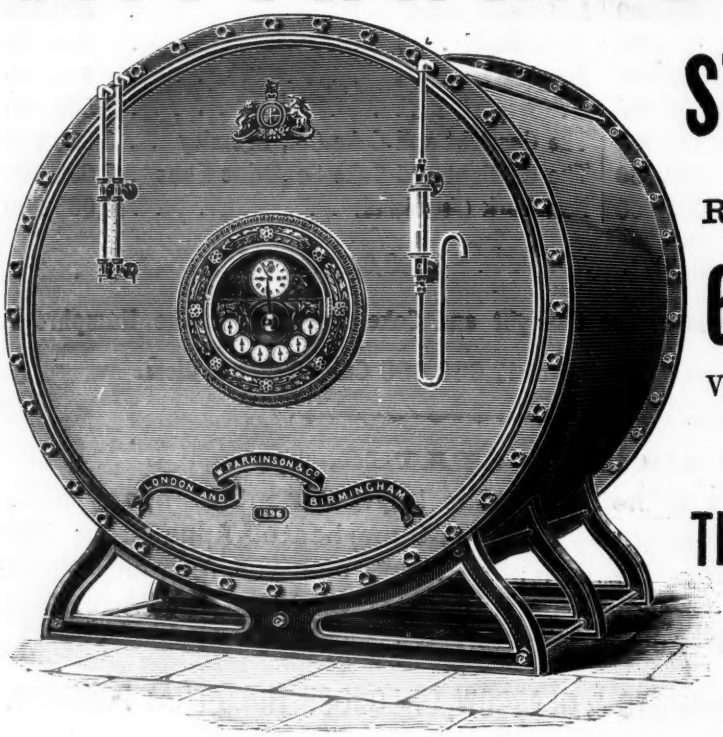

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[See also Advt. p 204.

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EDITORIAL NOTES.

The Approaching End of the Engineers' Strike.

THE abandonment of the demand for an eight-hour day, or a 48-hour week, in the London engineering trade, upon which the great strike and lock-out originated, was briefly recorded in these columns last Tuesday. Up to the very last moment the wire-pullers of the agitation that led to so disastrous a campaign, denied that there was to be any such confession of defeat; but they were at length compelled to notify the fact over their own signatures. To speak "by the card," the demand was originally preferred against only three firms—Middleton's, Maudslay's, and Penn's; so that the notice of withdrawal addressed to these firms by the Secretary of the Allied Trades Joint Committee would literally make an end of the matter. Possibly it would really have operated in this way if it had come at the end of the first week of the strike. When once a great war has been entered upon, however, the trivial causes that may have precipitated the hostilities disappear from the possible terms of peace. Mr. G. N. Barnes, in intimating to the Employers' Federation that the Executive of the A.S.E. concurred with the Allied Trades Joint Committee in withdrawing the demand for the 48-hour week, chose to ignore this consideration, and pretended to "assume that, inasmuch as the lock-out "notices were consequent upon the serving of the demand "for a 48-hour week, such lock-out notices will now be "withdrawn." The assumption was altogether unjustified. The engineering trade of the country has not been troubled for more than six months, and the Employers' Federation has not been extended and consolidated throughout the length and breadth of the land, merely in order that a demand for shorter working hours preferred against three London firms should be withdrawn. Mr. Barnes does not, or affects not to, know the rules of the game. The associated employers did; and they went on with their programme as if nothing had happened. They took note of the withdrawal of the demand for 48 hours; but inasmuch as they had never consented to entertain it as even discussable, its relinquishment made no difference in their policy or plan of action.

A routine meeting of the Executive Committee of the Employers' Federation was held in London on Wednesday, when the letters of Mr. David Brown, the Secretary of the Joint Committee, and Mr. Barnes, of the A.S.E., were duly considered. The answers sent were to the effect that if the various Society Executives should in the meantime agree to the terms of settlement "mutually adjusted "at the recent Westminster Conference," the works would be thrown open on the following Monday morning to as many men as there might be room for. On the face of it, this ought to have put an end to the trouble. The men's delegates to the conference recorded their willingness to recommend their constituents to accept the terms, if the masters would give way to the extent of three hours per week, or one-half of the original demand. Though reminded that the latter point had never been in question at the conference, and that the length of the working week could not be shortened, the delegates persisted in complicating the issue of their reference to the members generally by including this point. Now they have given up their demand for a shorter week, and there remains nothing more between the masters and men beside those terms of settlement which the conference found to be mutually satisfactory. Something, however, still stops the way. Probably it is only a question of time. The employers were desirous of showing the men that they were willing to begin to take them back at the earliest possible moment; but the proposal to try for a start as yesterday was rather sudden.

Meanwhile, the campaign tactics as undertaken by the Federation have been pursued more vigorously than ever. The posting of formal lock-out notices went on all over the country; and firms flocked into the Federation from all quarters. A cynic would say something bitter about those who wait to see which is going to be the winning side before joining in the fray; but the obvious reply is: "Better late "than never." In war there is nothing like pushing an advantage home; and the more men are locked out just now, the sooner will the inevitable end of the struggle be reached. Every day's delay tells heavily for the winning cause. At the moment of writing, there are two opinions

as to how matters are going. One is that the attainment of a settlement is little more than a formality. In Manchester, the idea is prevalent that the acceptance by the allied Trade Unions of the general terms lately adjusted by the Westminster Conference is a foregone conclusion, subject, of course, to certain assurances being given by way of saving the name of Trade Unionism. On the other hand, it is suspected that, having given up the demand for 48 hours by compulsion of the provincial men, who had no interest in it, the Executive of the A.S.E. are desperately endeavouring to prolong the conflict on the question of management. The little fact that the delegates to the conference themselves provisionally accepted the employers' terms would not be likely to weigh in the balance for anything if there were a chance of the provincial men making a good stand for better ones. At Leeds, on the East Coast, at Sheffield, and elsewhere, the locked-out men are reported to have declared their hostility to the Westminster terms. This is as may be. Officials of the Union may secretly encourage the men in this further revolt so long as there is any money forthcoming to pay their own salaries; but every fresh lock-out notice is a nail in the coffin of the strike. The best hope now is that after it is all over the men will ask themselves who has done most to "smash the Union."

At the last moment before going to press, we learn that the Executive of the A.S.E. have issued another document in which their members are advised "to vote for the terms "as now submitted, as settling the present dispute." It is offered as some explanation of this sudden change of policy at head quarters, that certain "notes" which were appended to the employers' terms have now been incorporated with this statement, producing the effect of considerably modifying the harshness of the terms as a whole. If the baffled strike leaders choose to cover their retreat in this way, it is their own affair. The true reason for the movement is probably given in the concluding lines of the communication, which amount to a confession that the funds for strike pay are entirely gone, and that there is no hope of help from outside. The employers' terms rest exactly as they have been before the world for weeks. It remains to be seen if the men will follow their leaders' wise, if illogical, advice, and agree to go in, wherever there is room for them, on the masters' terms. "In well-informed "Trade Union circles, the matter is treated as one which "does not leave room for doubt. The men, it is said, will "do exactly as their leaders order, although they have "most of them decided to get rid of those leaders as soon "as possible." This is, of course, the natural view of "Trade Union circles," where it is held to be the fundamental principle of all Trade Unionism that the members should follow their leaders. At the same time, the leaders of the present strike have mismanaged their business and abused their position so shamefully, that a display of resentment, in the form of rejection of their latest piece of advice, is quite possible. But nothing of the kind will avail to prolong the strike for an appreciable time, in the absence of money to "play" with.

A Consumer's Meter Registration Dispute at Bristol.

ANOTHER phase of the perpetual question of the legal connection between the indication of a consumer's meter and the amount of his liability for gas consumed has appeared at Bristol. It seems from the intelligence we have been able to glean—for the case was not properly reported, and we are consequently compelled to write of it with some reserve—that the question at issue this time was how far the right of a Gas Company to go behind the registration of one of their own meters, and make an adjusted charge, is affected by their action in continuing the use of the meter after the consumer had complained of its record. In this case, the consumer had his suspicions as to the accuracy of his meter, and communicated them to the Company, who looked up his past accounts, and concluded that there was nothing amiss. They offered, however, to have the meter tested, if the consumer would pay the expense in the event of it being found to register correctly. This offer was declined; and the meter went on with its work according to its lights. Seven months later, it became the Company's turn to impugn the reliability of the same instrument; and it was thereupon tested, and found to be going slow. As a matter of fact, it either wholly stopped registering at times, or only registered a proportion of the gas passing through it. Thereupon the Company made an adjusted charge for gas consumed during the previous six months, the amount of which was not excessive—being only 7s. 8d. over the indicated rental. A question of principle, however, was raised by the consumer; and we all know perfectly well what this means in a general way. In the present case it meant referring to the County Court Judge, who held that justice lay in making the Company abide by the indications of a meter they continued to trust after having had their attention called to its registrations. Consequently, he ordered the return of the surcharge they had made when they discovered that it had been wrong all the time—though in a contrary sense to the idea entertained by the complaining consumer. There is something ludicrous about this decision, at which it would be idle to cavil. If the Company were such sticklers for principle as the consumer in this case, they could have the judgment reviewed; but we take it they will hardly do this upon a matter of a few shillings. The circumstances are not likely to be repeated. The County Court Judge can scarcely have intended to imply that because a tradesman finds no reason at a particular period to doubt the accuracy of his weights and scales, or other measuring appliances, he must therefore be bound to abide by them at any subsequent period when he discovers them to be defective. Regarded from this point of view, the decision in question is ridiculous.

Last Year's Patents.

IT is observed in the current number of the "Engineer" that, in round numbers, 30,000 inventions were patented or protected last year. Actually, the number of applications was nearer 31,000; but the hundreds of such a total are unimportant. Our contemporary makes a rough guess at the money spent by inventors on Patent Office fees and other expenses, and arrives at the minimum estimate of £300,000. It calls this money "subscriptions to a national "lottery." But this outlay is far from representing the whole expenditure under the same head. Every patentable invention represents an amount of thought, and most of them have entailed some experimenting. If the money equivalent of this time and work were added to the cost of obtaining protection, the total charge upon the community by the Patent Office system would appear to be enormous, as it undoubtedly is. Our contemporary's comment upon all this is that the chance of any patent being worth anything to the patentee is very small. This is one of the obvious truths that nobody will take as applying to his own case. If so many clever people were not such fools, the Patent Offices of the world would go short of funds. As it is, the records of these institutions supply an unfailing succession of proofs capable of being used to disprove the thesis that man is a reasoning being.

The writer of the article marvels much at the persistency with which men go on inventing things that nobody wants—instancing railway car couplers, which are continually being patented here and in the United States at the rate of between three and four a week, though anybody connected with railways would know that there is not the smallest chance of any of these devices being adopted. As we have had previous occasion to remark, the same phenomenon has been repeated in the gas industry with regard to acetylene. Notwithstanding the glaring fact that to generate acetylene from calcium carbide is about as easy an operation as the sweetening of a cup of tea—not to mention the brewing of whisky toddy—a large sum of money must already have been spent upon Patent Office fees on "inventions" for attaining this object. Yet there are so many objects waiting to be attained in this work-a-day world, of which inventors one and all fight shy, while they pursue others which nobody wants, or which anybody can reach quite easily without their assistance! In another sense, the exclamation of the orator: "What "shadows we are, and what shadows we pursue!" applies to the things of that wonderful world which centres in the Patent Office. How empty are most patents! Yet when, in connection with some very urgent matter, one searches through the long list of possible "anticipations" of some patent that has proved successful, how pitiful appear the gropings of those who to an insufficient acquaintance with what has to be done joined an imperfect knowledge of how to do it! It is impossible to laugh at the poor patentee, troublesome as he often is, and futile as he is generally condemned to be. Most of us have laboured under his

disease at some time or other, and nobody living is wholly safe from all risk of infection; for this is a complaint that men can catch any number of times.

"Business" in 1897.

It seems rather late to mention anything further by way of comment upon the affairs of the past year; but, as a matter of fact, the concerns of modern life are so numerous and complex that the journalist who turns historian once a year has to divide his retrospective work into instalments. Thus it was only last Friday that "The Times" was able to make its customary statement respecting the course of "business" in 1897. This term has many applications in common speech; but from the point of view of the "City," business means all that mass of effort, all those causes and influences that find their ultimate register in the monetary centre of the world, which is the Bank of England. Here everything that mankind does for gain seems to focus. The Turk and the Greek cannot come to blows in their own little corner of Europe without interfering with "business;" and the celebration of the Diamond Jubilee also means that business is checked for a season. Our authority states that "the course of the Money Market has been interesting "and instructive;" but it is nevertheless one of those studies that only experts can pretend to fathom. Sooner or later, all the operations of the Money Market filter down to the man who wants to invest small savings in gas stock. Later still, they reach the poorer man who only wants to buy a loaf of bread. But the connection is not obvious. Take the single subject of gold, for example. How many men are there who could tell offhand what would be the effect upon the world's trade and finance of the extraction and placing on the market of 100 tons of gold from Klondike or elsewhere? We learn from "The Times" that the Bank of England is the first to feel the influence of a large or a short supply of gold. The Bank has to keep a certain stock of the only standard of the value of commodities in the world; and since the same substance is also in demand for industrial purposes, there are times when the demand exceeds the supply. Then the Bank has to see to it that the drain of gold is not too severe. At other times, new gold comes in largely, and there is plenty for all purposes. This has been the case of late; but it is expected that if the production of gold is maintained, the stock will so increase as to "reduce its value appreciably in the "course of a few years." When this happens, there will be disturbances of all markets which not everybody will be able to refer to the true cause.

"The Times" writer remarks upon the growing preference of British investors for home stocks, which has had several notable results. One of these is the fact that many companies have been able to issue debenture stocks at lower rates of interest than those carried by the previously existing stocks of the very same companies. It is mentioned in connection with "this downward movement in the rate of "interest, which perhaps has now been carried far enough," that in March last the Board of the United States Debenture Corporation actually claimed the right to go into voluntary liquidation solely for the purpose of paying off at par debentures which were described in the trust-deed "as irredeemable." This action was resisted as constituting a colourable evasion of the contract entered into with the debenture-holders, and was successfully resisted. Clearly, the proposal was an "immoral" one, as "The Times" characterized it; but it is easy to perceive the strength of the temptation to this new way of paying off old debts, perhaps contracted upon extravagant terms. It is further remarked: "A large number of new companies have been "formed and have invited subscriptions for capital during "the year. Many of them appear to be greatly over-"capitalized. Fortunately, there is reason to think that "the investing public have shown a good deal of discrimi-"nation in regard to them." It would be a good thing if the pestilent brood of promoters could be driven off for good and all by the notorious failures here referred to, so that capital for sound industrial ventures could be had on reasonable terms.

Inclined Retorts at Berlin.—During last summer 26 benches of inclined retorts, 15½ feet in length, were erected at the Gitschinerstrasse works of the Imperial Continental Gas Association in Berlin; and all were brought into work before the close of the year. Each retort carbonizes 660 lbs. of English coal in five hours, and the new settings give great satisfaction. They have been inspected by a number of experts.

WATER AND SANITARY AFFAIRS.

In the course of his evidence last week before the Royal Commission on the London Water Supply, Sir Alexander Binnie appears to have dwelt with some emphasis on what he considered to be a matter of fact—namely, that any new source of supply must be supplemental to, and not in substitution for, the sources now existing. Inevitably this must be the case for some time to come; and we find Sir Alexander saying that he would not at present abandon the existing sources of supply—the Thames and the Lea. There is no real concession here; it is simply a recognition of the unavoidable. The only statement which implies a qualification of a revolutionary change, is that the supply to be obtained from existing sources should be paid for under some scheme of purchase. Ten or fifteen years is the term which the Chief Engineer of the County Council allows for the undisturbed continuance of the present system. At the expiration of this period, the supplemental supply is to be introduced. As the requisite works will take a long time in execution, seeing that the supply is to come from some district in Wales, it is urged that the enterprise should be commenced at once—"the sooner the better." But how is the supplemental supply to come in? The Chairman asked the question: "Would you keep the supplementary supply "distinct or mix them up, good and bad?" Sir Alexander was unprepared on this point; and his reply was simply: "That I can hardly say." It would be specially interesting to know at least something as to the plan which broods in the mind of the Chief Engineer with regard to so vast a question. Perhaps Sir Alexander Binnie is just a little puzzled to determine exactly what is to be done with the Companies. Mr. Cripps was himself rather embarrassed in his evidence, when pressed as to the position that he assigned to the new water supply, and could only conclude that "all difficulties would be got rid of by purchasing the "undertakings." We question whether the Chief Engineer can get much farther than this. If the present works are not purchased by the time the aqueducts are flowing, what is to become of the water? Will it be supplied to the Companies in bulk? Even then the Companies must construct larger reservoirs to hold it. And what will be the charge for the supply thus furnished in bulk? Sir A. Binnie estimated that the cost of getting the Welsh supply will be from £90,000 to £96,000 per million gallons, according to the daily quantity. For a supply of 200 millon gallons a day, he calculated that the capital charge would be above £90,000 per million gallons. The capital of the Companies is quite £4000 per million gallons less than this; and the total capital employed by the County Council would be at least a million more than the outlay which the Companies have incurred. It has also to be remembered that, in regard to the existing supply, we are dealing with an accomplished fact; while in the other case we have to rely on an estimate. Moreover, there is this essential difference, that Sir A. Binnie's estimate is merely for getting the water, independently of the cost of the distributing plant. With this added, the extravagant character of the Welsh scheme becomes apparent; and we can the more readily apprehend why the County Council seek to purchase the Companies' existing works at a confiscatory price.

Supposing the Companies to be in existence when the supplemental water becomes available, they may then plead that they can get an additional supply of their own at a cheaper rate than the Council will require them to pay. If the Council fall back upon the argument that the supplementary supply is a superior article, proof may be forthcoming that there is nothing in it so superior as to justify the extra price. Mr. Dibdin has shown that, at a moderate expense, the Companies can so refine their river water as to make it equal to anything coming from Wales. Another question to be considered is whether the crisis is quite so near as Sir A. Binnie would make believe. The Royal Commission under Lord Balfour of Burleigh reckoned that the existing sources could be made to yield a sufficient supply up to the year 1931. But Sir A. Binnie's limit of fifteen years will only carry us to 1913—a date which falls eighteen years earlier than the period named by the Commission, according to which, if we allow fifteen years for the construction of the works required to bring in the supplemental supply, there is no need to commence operations

until the year 1916. But Sir A. Binnie would begin at once; and he doubtless looks upon the present Royal Commission as an unnecessary obstacle in the way. There must of necessity be a pause, awaiting the report of Lord Llandaff and his colleagues. If the previous Royal Commission came to a correct conclusion, there is no need for hurry; and the present inquiry can be allowed full scope. Sir A. Binnie is perfectly safe in saying that the existing supply will be insufficient some ten or fifteen years hence; but this does not prove that we must go to Wales for the increase necessary. If we are to rely on the previous Commission, there is no occasion for going beyond the watersheds of the Thames and the Lea to obtain an addition to the supply for at least thirty years to come; and if we allow fifteen years for the execution of the works, not a turf need be turned for a considerable time ahead. The report presented by that Commission would still further extend the period; the estimated population in the year 1931 being three quarters of a million in excess of what will really come to pass at that date, taking in Greater London and all the outlying parts of Water London, supposing the ratio of increase in the population to be maintained as it was between 1881 and 1891. The Commissioners gave at the close of their report a further opinion that a large supply of water might be obtained from the chalk area to the east of the Kent Company's district, without risk of damage to that area. But Sir A. Binnie calculates that the water supply of London must be more than doubled during the next thirty years; and he labours to show that the Thames, the Lea, and the chalk wells will not furnish what will be wanted.

The evidence now given by Sir A. Binnie, if it means anything, supersedes the report of Lord Balfour's Commission. Sir Alexander gives statistics as to the flow of the rivers and the growth of the population, and goes over the same ground that was traversed in 1893. We have fresh figures and altered data—with, of course, a different conclusion. It may be admitted that the day will come when the existing sources of the Metropolitan Water Supply will prove inadequate for the enormous population then having London for its centre. But there is reason to believe that such a day is much too far off to render it necessary or reasonable for the ratepayers of the Metropolis to plunge at once into the expenditure of many millions in order to provide for this remote contingency. We have yet to learn what the Water Companies have to say to the Royal Commission in regard to this matter, and in what way they are prepared to meet the wants of the growing population, so as to save—according to a reduced estimate—an addition of £14,000,000 to the taxation of the Metropolis, to be followed by £12,000,000 more. Sir A. Binnie says: "I do not look farther ahead than fifty years "from the present time." The outlook is so much the worse, though another witness may give a more hopeful prospect. Perhaps Mr. Cripps was right, in a peculiar sense, when he said all difficulties would be got rid of by purchasing the undertakings. With that accomplished, we might hear less of these supplemental millions. In a report which Sir A. Binnie presented to the County Council some little time ago, the estimated cost was as much as £38,000,000 for a supply of 415 million gallons of water per day.

Photography and Light.—The New York Correspondent of the "Standard" says Mr. Tesla has announced that his vacuum tubes are now so perfect as to take photographs surpassing flash pictures. Two seconds' exposure was used at a distance of 4 feet from a tube with a radiating surface of 200 square inches, giving a light of 1000 candles from current oscillations of 2,000,000 per second. He asserts that his system will give an equivalent light, without heat, from tubes the size of ordinary incandescent bulbs. Our contemporary's correspondent says this may be more scientific, but it is less amazing than the declaration by an hitherto obscure inventor, named Nickum, that he has obtained a brilliant permanent light from chemicals within a sealed globe. There are reputable witnesses of his light, which gives a cool, steady, mellow glow theoretically for ever, being inextinguishable and without waste. When it is not wanted, it is laid aside in a cupboard, or otherwise obscured. The only flaw in the story is that Nickum declares that the discovery which his light attests also disproves the theory of gravitation, and shows that a vacuum is impossible. The perpetual vibration of atoms is the basis of his principle, which as yet is equally difficult of proof or disproof—those admitted to his confidence having no scientific authority, according to the statement of our contemporary's correspondent.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 189.)

Business on the Stock Exchange last week was decidedly quiet—disappointingly so for those who are keenly on the look-out for the go-ahead movement which seems to hang fire. The prevailing tone, too, was dull and heavy; and prices in most of the chief departments show a slight fall. When the incidents of the week are considered, the wonder is that the fall was not greater. The Foreign Market suffered from the highly charged state of the political atmosphere; Home Rails, from disappointing dividends; Americans, from renewed Silverite agitation; and South Africans, from signs of ill-will in the Transvaal. The Money Market was extremely easy at first; but it hardened later on, and closed with a firm appearance. Business in Gas showed a great increase in activity compared with the preceding week; and the ruling tone was favourable. Several moderate advances were made in important issues, as against only one little move in the other direction. Gaslight "A" was naturally the centre of attraction. It is to have its 12¾ per cent. dividend next month; but at the cost of nearly £75,000 from the reserve fund. Then comes the question, Where it will be next August?—a question which each one must answer for himself as best he can. However, no such reflection appeared to trouble the market last week; and after some brisk dealing, the price rose from 314½ to 317, which was marked on Saturday. There was a fair demand for the secured issues; but prices for the most part were not remarkable, though the "K" preference rose three points. South Metropolitan, after going easily for some days, brightened up at the close, and marked 147. Commercials were hardly touched, and made no sign. The Suburban and Provincial division were just as quiet as usual; and the only feature was a slight set-back in Crystal Palace. The Continental Companies were fairly active. Imperial advanced a point; but the prices actually obtained showed no improvement. Union and European were firm. None of the rest were conspicuous, except that Buenos Ayres had a little rise. Business in the Water Companies was at a very low ebb. But the tendency was firm; and one or two quotations had a slight advance.

The daily operations were: Gas opened on Monday much more briskly; but prices showed no inclination to move. Tuesday's business was much about the same; but, as a matter of fact, the quotation of Imperial Continental was advanced 1. In Water, Lambeth tens rose 2. Transactions in Gas were decidedly quieter on Wednesday; and prices actually obtained still remained about the same, but Gaslight "K" gained 3. On Thursday, there was a revival of activity—Gaslight "A" leading the way, and making an advance of 1. Buenos Ayres improved ¾. On Friday, South Metropolitan and Imperial Continental shared the business with Gaslights. Crystal Palace receded 1½. Saturday was a very quiet day; but the tendency was very favourable. Gaslight "A" and South Metropolitan improved 1 each. In Water, West Middlesex rose 2.

ELECTRIC LIGHTING MEMORANDA.

The Dividends of the St. James's and Pall Mall and Westminster Electric Light Companies—Electric Tramway Table—No Technical Improvement—The Old Objections Remain.

It is announced that the Directors of the St. James's and Pall Mall Electric Light Company recommend a dividend after the rate of 14½ per cent. for the past year. The dividend of the Westminster Company will be at the rate of 12 per cent. for the year. These are returns on which the Companies are to be congratulated. It took the most successful gas companies in the kingdom considerably more than half a century at least to arrive at anything like so satisfactory a result as these undertakings have realized in about a fifth of the time. This circumstance shows the wide difference that has existed between the conditions under which gas and electric lighting have respectively been developed. The extraordinary prosperity of these two leading London Electric Lighting Companies is certain to be adduced as a proof of the essentially profitable character of electricity supply anywhere and everywhere. It may therefore be as well to remark that what it does really and truly prove is the contention that has always been urged in these columns whenever the nature of the elements of commercially successful electric lighting has been in question. It is the character of the district of supply, and scarcely anything else, that determines the issue of commercial success or failure in electric lighting. There is something to be said, of course, about the character of the system of supply in such a case; but the prime necessary in this respect is that the service shall be as reliable as skill and money and faithful attention to business can make it. There is no secret about the success of the St. James's and Westminster Companies. Their mechanical, electrical, and business methods are characterized by a highly respectable common-place practice. Their engineers do not profess to be able to generate electricity by any better means than burning the best steam coal and using the best machinery that money can buy. Their rental office does not attempt to dodge the accounts for current. It is all the plainest of plain sailing at the works and in the offices. But

the districts are well worth doing business in; and this is the bottom fact of the position of the undertakings.

The current issue of the "Electrician" contains a supplement sheet table showing the electric railways and tramways in operation, construction, or preparation in the United Kingdom. After so much has been said concerning the development of this branch of electrical engineering, it is satisfactory to have the facts presented in this intelligible form. According to the editorial comment of our contemporary, "the items in the present table show that there are some 23 lines in operation, that the construction of 25 others is sufficiently far advanced to make it probable they will commence running before the year is ended, and that there are now projected schemes for the construction of 10 underground electric railways in London, and 48 light railways and tramways in London and the Provinces. The lines in actual operation, together with such as will commence running in a very few weeks, comprise over 150 miles of track; while the aggregate track-mileage of lines working and in course of construction approximates to 400 miles." This is, on the face of it, a good showing.

Of technical advance or development there is little or no evidence. Our contemporary remarks that by far the greater number of schemes included in the table are on the overhead trolley system. For town tramways, neither the battery car nor the underground conduit system has advanced. Nothing is being done with the surface contact system; and the third rail conductor system is reserved for underground and overhead railways. It is argued that these facts do not go to show that electric traction construction is already crystallized, because improvements in matters of detail are continually being introduced. As evidence of this, we are bidden to note that one Traction Company are proposing to introduce the Falk system of cast welding rail-joints, claimed to be successful in Chicago and elsewhere. But it is impossible to regard copying as development. Nor is it possible to esteem the creeping into England of the trolley system of working tramways as anything better than a deliberate admission of one evil as offering a means of escape from another. We might have had the overhead trolley-wire system in all its glory, as soon as they had it in the United States. It was not the superior enterprise, progressivism, or anything else of the kind, of the American people that gave them the blessings of electric tramways, but their helplessness in the clutches of the street railway interest, and their apathy in face of what happens to their streets. We have known for years that the mechanical working of tramways means from one point of view electrical traction; and that far and away the cheapest expression of electrical traction was the trolley system. Only, until lately we have been hoping that electricians would be able to produce something better than this before it might become necessary to improve the working of British tramways. The hope has been vain. Our municipal and tramway authorities have held out against the trolley-wire abomination as long as they could, in deference to a feeling that cannot but be respected. They have felt that the overhead trolley wire was too high a price to pay for the undoubted benefit of rapid tramway service and the abolition of horse traction; but they cannot play the part of Sister Anne for ever. There is nobody coming to deliver them from the abominable thing; and they feel they must submit as to the inevitable. Tram-cars running along main lines of communication between city and suburb at the rate of ten or twelve miles an hour are worth some sacrifice to obtain.

Our contemporary's table jumbles together town tramways, light railways, and underground railways. This is confusing. The line of demarcation between a tramway and a light railway may not be always easy to draw, though the ideas appertaining to the two methods of transit are distinct enough. Town tramways, however, are different altogether from underground or overhead railways, and should not be placed in the same category with the latter. What municipal authorities are likely to seek in a table of electrical tramways is some indication that the cruder appurtenances of the overhead trolley system as tolerated in the United States, where nobody minds such things, are being removed or reduced to less objectionable forms in the nascent British practice. What is the best that can be made of the trolley system, and where it is to be found—these are the only practical questions about it for the time being. At present Leeds, Bristol, and Dublin seem to occupy the proud position of models for this kind of work. At any rate, there should be no need for municipal deputations to travel farther afield to see the best that can be done with the trolley system. The adoption of electric traction for British tramways will continue to be slow, so long as the method is handicapped by the necessity for putting up with the objectionable and most dangerous overhead wires; and not the least instructive feature of the "Electrician's" table is the absence of any proof that English Municipalities are taking up the system with enthusiasm.

The Award in the Mid-Sussex Water-Works Arbitration.—Sir George Bruce, the Umpire in the above-named arbitration, the concluding proceedings in which were reported in last Tuesday's "JOURNAL" (p. 133), has made his award, the amount of which is £46,138. The Cuckfield District Council—the purchasing authority—are to pay all the costs, which will come to something like £4000.

GAS BILLS FOR 1898.

(*Concluded from p.* 123.)

THE following Bills relate to the Gas Undertakings of Local Authorities:—

The Bakewell Gas Bill is to authorize the Urban District Council to acquire the undertaking of the Bakewell Gaslight Company, Limited. The Company was formed in 1848, and has a share capital of £1500. The works are built upon a leasehold site. The terms of transfer are given in a schedule to the Bill, and take the form of an agreement between the Duke of Rutland, as freeholder, the Company, and the District Council, whereby the land and works are to be bought by the last-named at the price of £1200. The agreement also provides for the acquisition by the Council of the Company's separate interest in the undertaking. The maximum price of 15-candle gas is to be 4s. per 1000 cubic feet within the Bakewell district, and 5s. for gas supplied outside a radius of 1530 yards from the Town Hall. The rate of interest on consumers' deposits is to be 3 per cent. The sum of £5000 is to be borrowed for extensions, repayable in 50 years.

The Blackpool Improvement Bill contains a part relating to gas and electric lighting. The limits of gas supply are to be extended. Powers are sought for making and dealing in gas-stoves and for the supply of gas in bulk beyond the limits.

The Coventry Corporation Gas Bill is to extend the limits of supply so as to include the parish of Exhall, in Warwickshire. Additional gas lands are required. Power to construct railway sidings is desired. Additional gas capital to the amount of £250,000 is wanted, to be repaid in 50 years.

The Edinburgh and Leith Corporations' Gas Bill is to authorize the Commissioners to construct new gas-works on a site at Granton. The works include a new road, a sea wall, jetty, and watercourse diversions. Additional gas capital to the amount of £400,000 is to be borrowed; the commencement of the sinking fund to be deferred for seven years. Power of inspection of fittings in new houses is sought. Clause 35 provides that "the Commissioners may, in addition to their recourse against the actual consumer, charge and recover from the tenant of any house who sub-lets his house furnished for any period not exceeding two months the amount of rates and charges for gas used and consumed, and any other sums due to the Commissioners by such sub-tenant during such sub-tenancy."

The Filey Water and Gas Bill is to authorize the compulsory acquisition by the Urban District Council of the undertaking of the Filey Water and Gas Company, whose last Act of Parliament was obtained in 1891. The maximum price of 15-candle gas is to be 5s. 6d. per 1000 cubic feet. A scale of discounts is proposed. Gas capital is to be paid off in 50 years. Surplus gas profits are to be applied in equal moieties in reducing the price of gas and increasing the district fund.

The Halifax Corporation Bill contains a part relating to gas. Additional gas capital to the amount of £150,000 is required; and extended gas lands are to be acquired. Power is specifically sought for the manufacture and supply of carburetted water gas. The Corporation seek to be enabled to provide gas gratuitously for illuminations on occasions of general public rejoicing. Power to inspect consumers' gas-fittings is desired, subject to regulations to be sanctioned by the Board of Trade. "A copy of all such regulations in force for the time being shall be kept at the office of the Corporation; and all persons may at all reasonable times inspect such copy without payment; and the Corporation shall cause to be delivered a printed copy of all regulations for the time being in force to every person applying for the same on payment of a sum not exceeding twopence for each copy." The new gas loan is to be repaid in 45 years.

The Ilkeston Corporation Bill contains a part relating to gas. The sum of £5000 is proposed to be borrowed for gas-works purposes, repayable in 50 years. A number of clauses relating to the supply of gas in bulk, stoves, &c., now usually inserted in Gas Bills, make up the rest of the part.

The Market Harborough Gas Bill is to enable the Urban District Council to acquire compulsorily the undertaking of the Market Harborough Gas Company, Limited, founded in 1833. The maximum price of 15-candle gas is to be 3s. 6d. per 1000 cubic feet. No penalty is to be incurred for imperfect supplies due to unavoidable cause or accident. Discounts of 10 per cent. for prompt payment and 20 per cent. for large consumption are contemplated. The sum of £20,000 is to be borrowed for extensions, repayable in 45 years.

The Middlesbrough Corporation Gas Bill is to enable the Corporation to acquire additional gas lands, and stop up a street. Specific power is sought for the supply of carburetted water gas, either alone or in combination with coal gas; everything done in this regard up to the passing of the Bill being also ratified and confirmed. Additional gas capital to the amount of £150,000 is required, to be repaid in 50 years.

The Morley Corporation Gas Bill is to empower the Corporation to purchase compulsorily the undertakings of the Morley and the Churwell Gas Companies. The former is a statutory Company, and the latter a private concern. The terms of purchase are to be determined under the Arbitration Act. The maximum price of 4s. per 1000 cubic feet is proposed for 16-candle gas, tested on the works or at the Corporation offices.

The burner for testing is to be a 24-hole Argand with a 7-inch chimney, or any other pattern approved by the Board of Trade on the application of the Corporation. No penalty for defective supply is to be incurred when it can be proved that the defect was caused by circumstances beyond the control of the Corporation, or was of so slight or unimportant a character as not materially to affect the value of the supply. Bye-laws for the regulation of consumers' fittings are to be sanctioned, and there is to be power of inspection and refusal to supply in cases of default. The sums of £45,000 for extensions and £10,000 for working capital are required. The former is to be repaid within 50, and the latter within 20 years.

The Yeovil Corporation Bill contains a part authorizing the transfer of the undertaking of the Gas Company to the Corporation. It is proposed that at any time within two years from the passing of the Bill the undertaking, which is the property of a limited Company, shall be purchased compulsorily. The maximum price of 15-candle gas is to be 4s. per 1000 cubic feet. Power is sought for establishing an electricity generating station on the site of the gas-works.

MR. COURTNEY ON THE BRITISH COAL SUPPLY.

At a recent meeting of the Royal Statistical Society, the President, Mr. Leonard Courtney, M.P., delivered an address entitled "Jevons's Coal Question: Thirty Years After." The speaker began by reminding his audience that more than thirty years ago the late Professor Stanley Jevons arrested the attention of the heedless world by making a certain statement respecting the duration—or, more correctly speaking, the exhaustion—of the coal capital of Great Britain. The impression thus created has never entirely faded from the public mind. At the time, considerable alarm was felt; and the Government of the day appointed a Royal Commission to investigate and report upon the data used by the economist, with, on the whole, reassuring results. It is more than likely that Professor Jevons would not have made the sensation he did but for the accident of his having won over Mr. John Stuart Mill and Mr. Gladstone to his view of the situation. Mr. Mill had a public of his own in those days; and Mr. Gladstone happened to be in a position to give instant effect to the acceptance which he had somewhat impulsively extended to Jevons's conclusions. It is necessary to distinguish, here and always, between Jevons's data and his conclusions and views. The data might be inaccurate, and the conclusions more logical than sound; but the practical outcome of his thesis was that as the coal supply of the country forms one of its principal assets, upon which the National Debt is secured, the progressive exhaustion of the one should be accompanied by a corresponding reduction of the other. It was the acceptance of this deduction by Mr. Gladstone, when Chancellor of the Exchequer, that lent impetus to the process of debt reduction which he inaugurated now more than thirty years ago.

Before proceeding to examine Jevons's coal question in the light of subsequent developments, it is expedient to make sure what it was that he said. Whenever a big question is raised by a man who is bold enough to disturb the equanimity of his generation in a particular regard, there is sure to be a serious amount of misunderstanding as to his real point. Jevons was, of course, misunderstood, both in his day and since. He has survived in popular memory, if at all, as the man who prophesied the speedy exhaustion of the British coal supply, which has not come to pass. Hence he usually ranks as a discredited prophet of evil; and the naturally optimistic world has small respect for seers of this quality. As a matter of fact, Jevons did not predict either the speedy exhaustion of the available coal supply, or even a serious enhancement of the price of coal due to scarcity. He merely took the rate of progress of coal consumption which had been realized at the date of his inquiry, and pointed out that if this rate were maintained the actual consumption would within a comparatively brief time overreach the means of supply. He therefore deduced the conclusion that the actual rate of increase of coal consumption could not be maintained. But if this were true, he thought certain consequences must follow. He anticipated that "the check to our progress must become perceptible considerably within the century from the present time—that the cost of fuel must rise, perhaps within a lifetime, to a rate threatening our commercial and manufacturing supremacy; and the conclusion is inevitable that our present happy progressive condition is a thing of limited duration."

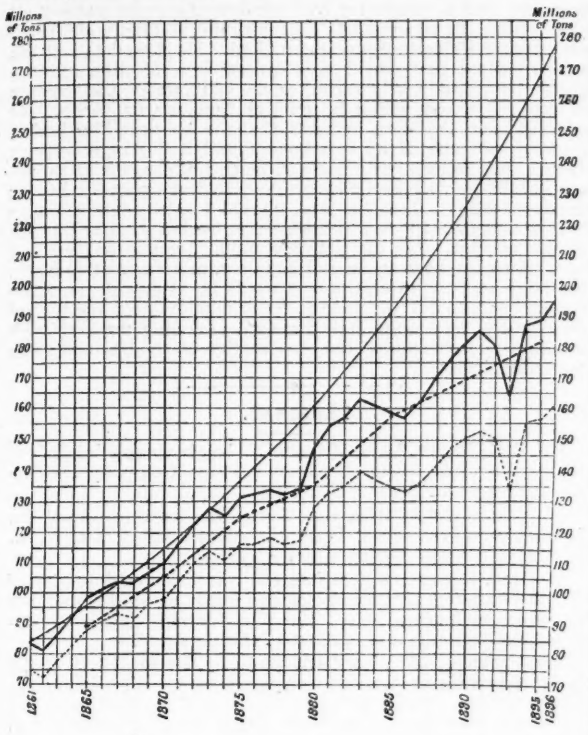
This was the proposition which Mr. Courtney set himself to examine in the light of experience; and, in order to do it, he divided the question into three heads: Whether there had been an abatement of progress in the production of coal; whether it had been accompanied by an increased cost of production; and whether there had been any arrest of the growth of those great industries which depend upon coal, and upon which our predominance has been based. As regards the first of these points, the figures justify Jevons. The rate of increase of coal production when Jevons wrote was 3½ per cent. per annum. In the years which immediately followed the appearance of the Professor's book, the rate of production actually became greater. But it soon slackened; and from 1871 onward the rate of increase declined, until by 1896 the output was almost exactly 30 per cent. less than it would have been had Jevons's rate been maintained. Hence his anticipation was to an extent fulfilled. When we proceed to examine the circumstances that have attended this partial realization, the aspect of the matter changes. Has the cost of coal risen in the way and to the extent considered by Jevons as a necessary concomitant of the restriction of output? The answer to this question is in the affirmative, with a slight qualification. In 1860, the price of coal at Newcastle was 8s. 5d. per ton. It shot up to 20s. 5d. in the "famine" year of 1873; but in 1896 it stood at 7s. 2d. These bare figures do not, however, reveal the whole of the truth. Prices taken at different periods must be corrected by reference to the purchasing power of currency. By Sauerbeck's standard, the 8s. 5d. per ton of 1860 becomes 11s. 7d. in 1896. Thus to this extent Jevons's anticipation has also been fulfilled, and Newcastle coal has become relatively more costly. Reserving for the moment the question of the qualification of this answer, let us proceed to the third and last point: Have the great industries of the country been detrimentally affected by these influences? Here Mr. Courtney becomes more than a little uncertain. He takes the example of the iron manufacturer, and finds in the competition of the United States the danger to the British industry which Jevons looked for in the restriction of the native coal supply. "In 1860, the production of iron in the United States was 821,000 tons; it reached 9,400,000 tons in 1895. In Great Britain, in 1860 the production was 4¾ times as great as in the United States; whereas in 1895 our production was to theirs as 77 : 94, or a little less than five-sixths." Hence England must be concluded to be in a bad way, and, according to Mr. Courtney, Professor Jevons is justified all through.

Is this a fair and reasonable conclusion to be drawn from the premises? Is Jevons really justified all along the line, and is Mr. Courtney a trustworthy critic of him and the actual position of the country? We make bold to answer in the negative to both queries. In the first place, the Professor's conclusions should be tested by application of the datum upon which they were based. He said the output of coal was increasing at a certain rate—true. He perceived that difficulties would arise if the rate were maintained for a sufficiently long period—true again. He thought that the rate could not be maintained, by reason of these difficulties—wrong. The rate was not maintained; but without reference to the difficulties, which were never met with. He thought that a diminished rate of coal output would mean a check to industrial progress—wrong again. He did not discriminate between *coal* and *fuel*. He thought the demand of the national industries upon the coal-fields must persist in the same relative proportions as had existed before his time—wrong, because he did not take account of the progress of fuel economizing. He thought that it would be the advanced price of coal, and this only, brought about by the process he indicated, that would jeopardize "our commercial and manufacturing supremacy"—wrong, several times over. Coal may be dearer at Newcastle than it was thirty years ago; but in every national industry the charge for fuel is a largely reduced item of the cost of production. In short, apart from the single success of Jevons in predicting that the output of British coal could not go on increasing at the rate he found to prevail for his own time, nothing else can be justly shown ot justify him.

What has the American coal and iron trade to do either with the duration of the British coal supply or the prosperity of British trade? We do not want to mine all the coal and make all the iron and steel that are needed by the world at large. The statistical fact that the United Kingdom held a preponderating share of the world's trade of any kind at a particular epoch goes for nothing in the long account. The Jevons method is vitiated in the degree in which it treats ratios of increase or decrease as concrete facts susceptible of one interpretation. Granted that from 1860 to 1865 the output of coal in this or any other country exhibited a certain rate of increase. It is easy to see that the limitless extension of this movement is impossible, for a variety of reasons. After a time, the whole population of the country would be required only to work the coal mines, which is to reduce the proposition to an absurdity. As "The Times" put it: "Mr. Courtney's survey is interesting so far as it goes; but it would have to be widened indefinitely in order to afford a solid basis for his conclusions."

Since Jevons wrote, there have been introduced into the great national industries depending upon coal, means of economizing fuel, and standards of efficient performance, which have silently effected a revolution almost as great as the introduction of the power-loom did in the textile industry. If Mr. Courtney had inquired how much farther a ton of coal will carry a ton of cargo now as compared with the practice of 1860, or how much less fuel it takes to make a ton of steel, he would have pitched his reflections upon Jevons in a different key. It is unnecessary to say anything here about the growth of the gas industry during the last thirty-five years. So long as arm-chair economists talk about coal, as Mr. Courtney does, without taking account of the difference between the words "coal" and "fuel," so long will they lie under the reproach of being unpractical. What is the conclusion of the whole matter? That the condition of the industrial population of this country, coal users as well as well as coal getters, has greatly improved

during the past thirty-five years, when according to Jevons the reverse experience should logically have been realized. The coal output has not been maintained at the rate of increase he regarded as normal; and the cost of coal has risen. Yet the increased well-being of the masses of the population is indisputable. They earn more, spend more, and save more than ever before in the history of the nation. This being the fact, the non-academical world will not stop to discuss the Jevonses and Courtneys at great length. It will conclude that, for all their cleverness, there are more things in heaven and earth than are dreamt of in their philosophy; and when this can be said, the argument is closed.



We reproduce the diagram illustrating Mr. Courtney's paper, which shows at a glance how Professor Jevons's calculation compares with the facts. If one could show on the same diagram the amount of work done by the coal used at home and abroad in 1861 and 1896, the picture would be more striking still.

SUPPLEMENTARY WATER-MAINS FOR FIRE EXTINCTION.

In the course of the inquiry into the cause of the great fire which occurred in the City of London last November, which has resulted in a verdict of arson, the practicability of having a separate set of mains, as well as underground water-tanks, for fire-extinction purposes, was suggested. As may be remembered, Mr. E. Collins, M.Inst.C.E., who gave evidence on behalf of the New River Company, stated that the cost of such tanks would be prohibitive, but that his Directors would nevertheless assist the authorities in any way they could in this matter, should a scheme be entertained. The question of having separate mains has a certain amount of feasibility, especially in the cases of large towns situated upon rivers. This subject has lately been investigated by Mr. Foster Crowell, M.Am.Soc.C.E., for the Fire Department of the boroughs of Manhattan and the Bronx, New York City; and he has presented a report thereon, from which some extracts have been given in the "Engineering Record." It appears that auxiliary fire-mains are already in use in Cleveland, Milwaukee, Detroit, and Buffalo; and they are now being introduced in Boston. They form distinct underground systems, and are primarily for the purpose of utilizing the available power of the fire-boats in extinguishing fires at points too remote from the water fronts to be advantageously reached by lines of hose. Mr. Crowell visited in turn all the cities named, and secured the information and data concerning the character, dimensions, efficiency, and cost of the pipe-lines upon which his report is based. It may not be without interest to those of our readers who have charge of water-works to reproduce some of the particulars the author has collected.

Beginning with Cleveland, we find that fire pipe-lines were first introduced in 1888. In that year, an ordinary 6-inch cast-iron pipe was laid from the river bank to the top of the adjoining bluff—a distance of 700 or 800 feet only—without any idea of extending the system. But its advantages became so marked that in 1891 extensions were begun; and they have continued until now there are four lines in service, comprising a total length of 2650 yards, the longest distance covered by one line being about 800 yards. Provision has been made for further extensions. On all the newer work, 8-inch pipes were used; but the original 6-inch pipes are still in service. As a necessary consequence, large friction losses occur; but, notwithstanding this drawback, the advantages obtained are very great. Mr. Crowell gives the following account of a test he witnessed: Three lines of 3½-inch hose from a fire-boat were connected to the 6-inch fire-pipe, which was empty at the time; and at a hydrant 1800 feet distant connection was established between the pipe-line and a water-tower apparatus, which was extended to a height of 65 feet. The elevation of the hydrant above the level of the river was 80 feet; making the total height to the nozzle 145 feet. The fire-boat possessed four pumps, having a combined capacity of 6000 gallons per minute; and they were all used. After the pumps were started, 55 seconds were occupied in filling the pipe. Two 2-inch streams were projected from the water-tower with 140 lbs. steam pressure and 260 lbs. water pressure in the pumps; the gauge at the water-tower indicating a pressure of 65 lbs. A second test was made with two lines of hose from the hydrant throwing a 2-inch and a 1¾-inch stream. Communication was had with the fire-boat by means of overhead telegraph wires. It appears that there are two fire-boats in constant service.

A fire pipe-line was first introduced into Milwaukee in 1889. The city is now provided with 24 separate lines, having a total length of about seven miles. The first installations were with 6-inch pipes; but these have since been replaced by 8-inch and 10-inch pipes. The present rule is to proportion each line to its special service—10-inch being the maximum. Many of the lines are planned for future extension; and it may be said that this system is destined to be that on which the city will chiefly depend. On account of the low temperature at the time of Mr. Crowell's visit, it was not deemed desirable to exhibit the working of the system in the heart of the city; but a very satisfactory test was made on a line 3000 feet long, consisting of 10-inch and 8-inch pipe, in the south end, from which two powerful streams, one 2 inches and one 1½ inches wide, were thrown. He was shown photographs of other tests—one being on a 10-inch line 2158 feet long, where a 2½-inch stream was thrown over the Statue of Liberty on the Court House, the height of which is 198 feet above the hydrant, and 255½ feet above the level of the river. In another test, six 1½-inch streams were thrown over buildings 150 feet high. There are three fire-boats in service in Milwaukee; the capacity of each being 6000 gallons.

In Detroit there are available for fire extinction fourteen completed pipe-lines, 8 and 10 inches in diameter, having an aggregate length of nearly five miles, mostly on parallel streets running at right angles to the Detroit River. At present they are served by one fire-boat, with a capacity of 6000 gallons per minute, when working at the maximum pressure; but it is proposed to bring the nine principal lines into communication with each other by means of a 12-inch main parallel and near to the river, connected with a permanent pumping-station of 5000 gallons capacity operated with steam from the public electric lighting plant. This will relieve the fire-boat, and practically double the pipe-line efficiency, as well as save time in getting the streams of water started. The working of the system was demonstrated to Mr. Crowell by a satisfactory series of tests on a line consisting of an 8-inch steel pipe 2250 feet long. The fire-boat was connected with the main by five lines of 3½-inch hose. The first test was carried out with two 1¾-inch streams; the water pressure at the pump being 200 lbs., and 90 lbs. at the back of the nozzles. The second test was made with three lines of 3½-inch hose from the hydrant, brought together into one 1¾-inch nozzle. This made a magnificent and very powerful stream; the gauge at the back of the point of junction indicating 180 lbs. The third test—a 2-inch nozzle—was substituted; the gauge pressure being 180 lbs. as before. In the fourth test, a 2¼-inch nozzle was used with a gauge pressure of 150 lbs.; and in the fifth, a 2½-inch nozzle with a pressure of 143 lbs. A record of previous tests made on another of the Detroit lines, 4800 feet in length, was as follows: Three 1¼-inch streams, through 100 feet of 3-inch hose, were thrown 225 feet; two 1¾-inch streams, through the same length of 3-inch hose were thrown 250 feet; and two 2-inch streams with the same hose were thrown 325 feet. The Detroit pipe-lines and their appurtenances have been very carefully and skilfully designed. Steel pipe, 8 inches in diameter and 28 lbs. to the foot, lap-welded, with screw couplings, was selected. It is dipped in asphalte, and tested to 1000 lbs. It is laid on a straight grade; the rise being only 19 feet in 2000 feet. The slope is in the direction of the river; and it just suffices to permit the draining of the pipe by gravity as soon as the pressure is removed. The hydrants have a 6-inch stand-pipe, with two 3-inch hose outlets and one 4-inch outlet. Brick manholes are built opposite each hydrant, and a wire is run alongside the pipe to establish telephonic connection between each hydrant and the boat.

It is but recently that the fire-pipe line system has been introduced into Buffalo; and only one line has been constructed. It is remarkable, however, for being of greater length, larger

diameter, and better equipment than any other now in service. The line extends a distance of 6200 feet; its highest point being about 50 feet above the level of the river. It is of wrought iron, 12 inches in diameter, and weighing 50 lbs. per foot, with screw joints. The sections were tested to 1000 lbs. per square inch; and the line complete, after laying, to 300 lbs. There are 26 special hydrants, each with four 3½-inch openings; the branches and stand-pipes being 8-inch. The valves are three-way, so constructed that any hydrant can be cut off and the line left open, or the line can be shut off at that point. Connection with the fire-boat is made by means of two branches, which unite a short distance up the line. Each branch terminates in a cylindrical chamber, with seven openings for 3½-inch hose. There are two fire-boats, having a combined capacity of 10,000 gallons per minute. With both working together, the entirely empty line can be filled ready for five streams in 3 min. 40 sec. Electric communication with the fire-boat is provided near each hydrant. The Buffalo officials estimate that their pipe-line, complete with all the appurtenances, has cost about 14s. 7d. per lineal foot, or about £4400 for the line.

The pipe-lines of which we have given particulars were laid for carrying fresh water. They consequently failed to furnish one important element of information needed for the guidance of the New York authorities—viz., the effect of salt water upon the appliances employed. An instructive example is, however, afforded by Boston, where a salt-water line is being introduced; but as it is not yet in service, no experience in this respect has been gained on this particular point. But the results of observation as to the effect of salt water upon metals is available; and, in the light of experience with cast-iron water-pipe that has for many years conveyed a fresh water supply under salt water, this material has been adopted for the fire pipe-line, with solid composition metal valves, gates, and fittings, with pure rubber inner joints. The diameter of the pipe is 12 inches, and the metal is 1 inch thick. Special precautions have been taken against leakage; 40 lbs. of lead being used for each joint. The pipe is coated at the foundry, both inside and out; and the line has been tested up to 400 lbs. per square inch. Mr. Crowell carefully inspected the part of the line under construction at the time of his visit. The line is about 3900 feet long, with both ends at the water side. Each end will have two fire-boat connections, so that both boats, each of 3000 gallons capacity per minute, can connect at either end, or one at each end, as may be most convenient or expedient. Each connection has six 3½-inch butts. There are eleven post hydrants on the line, each having three 3-inch outlets, with independent valves. Each hydrant may be gated off from the line. There is a check-valve for each, and an air-escape valve about 450 feet away. By means of a tank on the roof of the Post Office, which is supplied from the fresh-water system, the hydrants can be flushed out whenever the pipe-line pressure is taken off; but it is not intended to flush the pipe itself under ordinary circumstances. Being below the level of the tide, it will be generally filled with salt water. In the pipe-trench, above the pipe, is a 4-inch duct, through which the electric system communicates between the fire-boats and each hydrant; the signal-box being contained in a small compartment designed to receive it at the back of the hydrant casing. All the gates and mechanism of the hydrants are of composition metal. The officials estimate that the length of pipe under construction will cost at the rate of 25s. per foot, including all material, fittings, and labour, or £4800.

Mr. Crowell next proceeds to set forth his views in regard to a fire pipe-line for New York—the special object for which his investigations were undertaken. He prefaces them, however, with a few observations on the general considerations involved. He first of all expresses the opinion that, on economical grounds alone, the use of the enormous available power of the city fire-boats at fires occurring beyond their limited hose radius, would be found to justify the expense of the installation of the pipe-lines. In the second place, the greater size and power of the streams of water obtained from this source enable the pipe-line to do far more effective work on a fire than is possible with streams from engines. He points out that "much of the water of small streams is evaporated in fierce fires as it passes through the flames, and may even in certain situations serve to increase the heat; but a large stream may have sufficient body and momentum to reach the very heart of the fire." Then, with a separate pipe-line, opportunity is afforded for having a roof-pipe service; while practically unlimited quantities of water may be concentrated at any point. It moreover in many cases allows of the first streams of water being thrown upon a fire in less time than under ordinary conditions; and—though perhaps this is not a matter of primary importance—it affords means of flushing sewers and streets at little or no apparent cost. He goes on to remark that there are no unsolved engineering problems involved in the introduction of the system in New York; but he points out that the study of the local questions which should determine the extent and character of the first experiment should be complete, in order that it may serve as a useful part of future extensions of the system if found desirable. His recommendations must, therefore, be regarded as tentative in respect of the location and scope of the experiment, although unqualified as to the desirability of carrying it out on a broad scale.

The recommendations above referred to are set out in the concluding portion of Mr. Crowell's report. The first important question to be determined is the size of the pipe; for this affects not only the practical and economical working of the line, but also the extent of the part of the system dependent upon any pumping-station. It is a natural law that the larger the diameter of the pipe the less will be the losses due to friction; and, as this is a vital question, Mr. Crowell thinks it would be desirable to have the pipe as large as possible, consistent with strength and economy, provided it could be kept constantly filled, so that no time should be lost in filling it for a fire. From careful consideration of the experience gained on this point in the other cities, and calculations based upon the greater capacity of the New York fire-boats, he recommends that 14 inches be the inner diameter of main pipe-lines, 12 inches for street branches and 8 inches for hydrant branches, with gates at all intersections for the purpose of restricting to the necessities of each case the length of pipe to be filled. He gives details of the auxiliary plant that would be required in connection with the installation, and finally furnishes an estimate of the expense of carrying it out, which he puts at $300,000, or £6000. He reckons, from the data to hand, that the fire-boat *New Yorker*, working only one of its two boilers and half its pumps, can deliver 5000 gallons per minute at the end of the pipe at Broadway, while maintaining a constant hydrant pressure of 90 lbs. for the fire streams. This, he says, should furnish eight effective fire streams through 1¾-inch nozzles, or twelve streams through 1½-inch nozzles. But this delivery could, of course, be increased by working the boat to its full capacity, or by using two boats. Running at half power, the boat would be able, with the entire system open, to fill the pipe in seven minutes from the time of starting the pumps at full pressure, assuming "a very high standard of perfection in the construction of the line and all its appurtenances."

PERSONAL.

Mr. F. S. Cripps, Assoc.M.Inst.C.E., has been appointed Consulting Engineer to the Leatherhead Gas Company and the Leatherhead and District Water Company.

The Leeds Corporation Gas Committee have appointed Mr. A. Edwards Analytical Tester in succession to Mr. W. E. Pettigrew, the new Manager at York Street.

Mr. H. J. Robus has accepted the consulting engineership of the Shoeburyness Gas Company, and under his supervision new works are to be constructed, the plans for which are being prepared by Messrs. J. & H. Robus, of Bucklersbury.

Some changes have just been made by the President of the Local Government Board in connection with the engineering inspectorships. Major Hector Tulloch, C.B., R.E., who has for some time been the Chief Engineering Inspector, has retired, and Major-General C. Phipps Carey, R.E., his Deputy, succeeds to the position; Colonel J. O. Hasted, R.E., taking the place vacated by Major-General Carey.

Our readers may remember that, at the meeting of the British Gaslight Company, Limited, in the spring of last year, the Directors in their report announced the retirement of the Secretary, Mr. Frederic Lane Linging, after 38 years' service. The Chairman (Mr. Horsley Palmer), in the course of his address, made feeling allusion to the severance of this long connection with the Company; while the sentiments of the shareholders were voiced by Mr. George Livesey, who proposed a resolution in which a cordial recognition of the great services rendered by Mr. Linging was allied to the expression of a hope that, even in his well-earned retirement, they might not be "deprived of his advice and assistance." Mr. Livesey emphasized this portion of the resolution by remarking that, if there was a possibility of putting Mr. Linging upon the Board, he was sure it would be gratifying to the shareholders to see him there. We learn that their wish is now realized, as Mr. Linging has been appointed a Director of the Company.

Economical Tank Construction.—A gasholder tank on somewhat novel lines is being constructed for the Sutton Gas Company by Mr. F. S. Cripps, Assoc.M.Inst.C.E. The wall is being built with the excavated clay, which is burnt into ballast and used for concrete. The wall is then backed by more of the clay in the form of puddle. The materials are thus utilized on the ground to the greatest possible extent; thus saving the trouble and expense of carting away.

The Institution of Mechanical Engineers and Gas-Engines.—Some time ago a Committee was appointed by the above-named Institution to inquire into the subject of "Gas-Engines." Their first report, containing a description of the apparatus used and the methods adopted, and giving the preliminary results of the trials carried out, prepared by Professor F. W. Burstall, of Birmingham, will be presented at the annual general meeting of the Institution on the 10th and 11th prox.

Danger of Fire from Incandescent Gas-Lamps.—A notification has been issued by the Chief of Police in Berlin to the effect that, in consequence of the frequency of fires due to the ignition of wooden beams in buildings by the flame of incandescent gas-lamps placed too close to the ceilings or beams, these lamps must in future either be fixed at least 40 inches below, or be provided with a sufficiently large shield to protect the woodwork. The shield must not be affixed to the ceiling, but be attached to the lamp or else suspended from an adjoining brick wall.

NOTES.

Utilizing Sawdust for the Manufacture of Calcium Carbide.

We learn from an American contemporary that a scheme has been laid before some of the lumbermen of Ottawa by which the sawdust, which has been a serious source of annoyance in the Ottawa River for many years, is to be utilized for the manufacture of calcium carbide under a process patented by Professor Wilson, of Ontario, whereby the sawdust, slabs, bark, and all refuse from sawmills can be rapidly converted into carbon. This carbon is powdered and mixed in equal quantity with limestone; and the mixture is then subjected for ten hours to an intense electrical current, strong enough to convert iron into a boiling mass and lead into an explosive gas. The result is calcium carbide. The mass is broken into small lumps, and in this form is supplied in tin cans to consumers. Ottawa offers exceptional advantages for its manufacture, because of its unlimited water power and supply of raw material.

The Use of the Sand-Blast for Cleaning Ironwork.

Mr. E. P. North, the Consulting Engineer of the Department of Public Works of New York City, has written to a correspondent an emphatic recommendation of the sand-blast process of cleaning structural ironwork for painting. The substance of this interesting communication is published in the "Engineering Record." It appears that certain Baltimore bridges have been sadly neglected for some years—in fact, one of them has never had a coat of paint since its erection twenty years ago. When taken in hand for cleaning and painting, the rust scale on the metal work was more than ¼-inch thick, and the iron and steel scantlings were filled to depths of from 1-32nd to 1-16th inch. One thing was specially noticed—that the erector's numbers, presumably painted in white lead, were still distinct; and under them the iron was perfectly clean. Chipping hammers, steel scrapers, and brushes were used to clean the bridge, at a cost for labour of about 5 c. per square foot; but the result was not at all satisfactory. It was practically impossible to keep the labourers up to the proper standard of cleaning; and they had an incurable propensity for hurrying over the work. While the job was in progress, the Engineer became persuaded of the superiority to hand cleaning of the sand-blast process; and he accordingly adopted it. With a view to overcoming the recognized difficulty of getting a good protective first coat of paint upon structural ironwork while in the constructor's shops, he advises that all such establishments should be required to set up a sand-blast plant for thoroughly cleaning mill-scale as well as rust from new iron, before the metal receives its first shop coat of paint or oil.

The Hamburg Fire Tests of Materials.

In the course of the discussion upon the recent disastrous fire in the Cripplegate district of the City of London much has been heard of the Hamburg tests of fire-resisting materials and construction. These tests were originated and carried out by a strong Technical Commission, and resulted in some valuable generalizations respecting the behaviour of structural members in a fire. As summarized by the "Builder," the report of the Commission would practically read as follows: Wrought-iron uprights, if unprotected, show little power of resistance to fire, collapsing in a temperature of over 600° Celsius. The filling in of such uprights with concrete only slightly increases the resistance. Protecting them with non-conducting materials very greatly increases the resistance. Wooden uprights, if unprotected, catch fire at temperatures under 600° Celsius; but even when well alight they have a greater resistance than unprotected wrought-iron uprights. Neither wooden nor wrought-iron uprights give any warning of an impending collapse. Unprotected cast-iron uprights—that is to say, columns—when loaded to the extent of 500 kilos. per square centimetre, collapse at temperatures varying from 750° to 850° Celsius. Their resistance depends very greatly on the load and section; and it can be very materially increased by protection. Subsequent tests have been made by the Hamburg authorities upon cast-iron columns loaded and unloaded, protected and otherwise, upon which a powerful gas heat was permitted to play. It was found that jets of water directed on the heated columns had no effect till deformation by heat had already set in. Protecting metal by different non-conducting coatings delayed deformation from half an hour to four or five hours.

An Integrating Steam-Indicator.

It is observed in "Engineering" that numerous attempts have been made from time to time to construct an instrument capable of integrating continuously the work done in the cylinder of a prime motor under all conditions of varying load, so that the total amount of energy generated during any period would be recorded. The latest instrument of this description is the invention of Mr. W. G. Little and Mr. C. W. G. Little, of Bexley, Kent. In it the principle of the planimeter is taken advantage of to produce a continuous record upon a counter which is actuated directly by the axis of the wheel of the planimeter itself, and which is so constructed as to run at even a high speed for a length of time, without attention. The action of the instrument is virtually that of a planimeter, in which an inclination of the planimeter wheel is effected by the varying pressures of steam on the indicator piston, in such a way that the amount of rotation of the wheel is proportional to the steam pressure producing such inclination. This fundamental idea of the instrument is intelligible enough; but a vast amount of ingenuity has been expended in carrying it into practice. Professor Unwin has reported on the instrument, the value of which he fully concedes. As the number read off the counting-wheel at a glance is proportional to the horse power per revolution, a very simple calculation gives the mean horse power of the motor during any special time when the revolutions have been observed. It is admitted that only lengthened experience with engines of different speeds will show whether or not Mr. Little's instrument can be satisfactorily substituted for an ordinary indicator; but the apparatus seems to be fairly reliable, and to offer power users a means of showing what their engines are actually doing at any particular moment. This information has hitherto been lacking.

A Mechanical Theory of the Divining-Rod.

The perusal of the review which appeared in "Nature" a few months ago of Professor Barrett's contribution to the "Proceedings" of the Society for Psychical Research, on the subject of the divining-rod (to which reference was made in a "Note" in the "JOURNAL" for Nov. 30), has brought to the mind of Mr. M. E. Wadsworth, of the Michigan School of Mines, a purely mechanical theory of the rod which he had some years ago from a friend. This theory, which he says has been repeatedly tested and shown to be correct, he has since sent to "Nature." The process described is as follows: Take any forked twig of a reasonably tough fibre in the clenched hands with the palms upward. The ends of the limbs forming the twig fork should enter the closed fists on the exterior side of each fist—*i.e.*, on the two sides of the clenched hands farthest from each other. When a twig is grasped in this position, it will remain stationary if held loosely, or with only a moderately firm grasp; but the moment that the grasp is tightened, the pressure on the branches will force the end of the twig to bend downwards. The harder the grip, the more it must curve. The curvature of the twig is mechanically caused by the pressure of the hands forcing the limbs to assume a bent and twisted position; or the force that causes the forked limb to turn downwards is furnished by muscles of the hands, and not from any other cause. Mr. Wadsworth says the whole secret of the divining-rod seems to lie in its position in the hands of the operator, and in his voluntarily or involuntarily increasing the closeness of his grasp on the two ends of the branches forming the fork. If the foregoing conditions are fulfilled, the twig will always bend down—water or no water, mineral or no mineral. Anyone can be an operator, and any mineral can be used for the instrument, provided the limbs forming the fork are sufficiently tough and flexible.

COMMUNICATED ARTICLE.

IS DUSTBIN REFUSE A FUEL?

By NORTON H. HUMPHRYS, Assoc.M.Inst.C.E., F.C.S.

The references that have been made in these columns to the success of the municipal destructors erected at Shoreditch as a medium for raising steam to be applied to the generation of electricity and other purposes, come as a surprise to many who have good reasons for believing that dustbin refuse is not a fuel; and therefore that, so far from being a source of heat, it does not contain sufficient potential energy to ensure its own destruction, but requires additional fuel from some outside source for that purpose. This is not merely a matter of opinion. The modern cry of "Every householder's electric light from his own dustbin," is only a new setting of an old tune. Long before the possibilities of electricity took the public fancy, and became a cheap and safe topic for anyone who wishes to pose as a platform scientist, the idea was propounded that the household dustbin contained among its treasures a sufficient quantity of carbonaceous matter to furnish, with or without the aid of the grease and suds that are usually disposed of through the medium of the scullery sink, a sufficient supply of gas for any reasonable amount of artificial lighting. But practical investigation soon laid bare the fact that ordinary household refuse was loaded with moisture and incombustible matter to such an extent that, even when provided for nothing, it was more costly as a gas-making material than ordinary coal at current prices. It resembled in this respect certain varieties of peat, which in their natural state are so loaded with earth and moisture as to be useless for fuel purposes. But the peat can be air-dried by simply cutting in sods and storing under cover—a process which is obviously impracticable in the case of house refuse.

In many localities, there are waste tracts of land, upon which household rubbish is deposited in large quantities; and a favourite amusement with street urchins is to rummage about and gather up scraps of paper for a surreptitious bonfire. The fire, however, never spreads. If the mass was inflammable, the ready means of disposing of it that are thus suggested, would have been put into practice long ago. Instead of paying a contractor 2s. or 3s. per load to get rid of the stuff, it would simply be taken to the nearest patch of common or waste land, and there destroyed by fire. Further, there is a demand for

fuel in every household. If the refuse is inflammable, there is a destructor at hand, in the form of the kitchener, the scullery stove, or the copper firehole, where all waste matter could be got rid of at once, instead of being stored on the premises for a week or so before being fetched away. There is not only the cost of collection and removal, but frequently this also means conveyance through, or round to the front of, the house. The process, particularly in warm weather, is anything but satisfactory, and would be gladly avoided if there was any possibility of doing so by burning it on the premises. And when the modest 5th of November carnival is held in the back garden, and every scrap of paper, old boxes, or other inflammable matter is hunted up, why are the contents of the dustbin left untouched? Simply because they are not inflammable, and that being so, where does their value as a fuel, for raising steam, or for anything else, come in? Anthracite and other kinds of fuel that are useless for household purposes can certainly be consumed under forced daught and other ingenious devices; but no amount of mechanical ability can convert a substance that is not inflammable into a useful fuel.

There is no reason for surprise at the fact that the contents of the Shoreditch dustbins should be brought in as an item in the calculations of those who talk and write about cheap electricity. The science of electricity has been advanced to a state of great precision. An important feature is the extreme delicacy of many of the instruments used. One would suppose that the facility for mathematical calculation in respect to almost every point in connection with the generation or distribution of electricity that is thus rendered possible, would tend by the natural sequence of things to produce a steady-going, hard-headed individual, who proved everything by experiment and deduction, and was free from the weakness of an erratic imagination or fervid flights of fancy. Yet it seems to have a contrary effect; for there is, among those who ought to know better, more wild talk about the possibilities of electricity, than on any other known topic. Edison's invention was the indirect cause of a great deal of oratorial extravagance, in which the utter displacement of gas was only one item. Lately there are signs of a repetition of this craze—the old dislike of gas being still retained; and the modern form of the delusion is that, light for light, electricity is much cheaper than gas. Electricians go into a town, and if there is a stream of water large enough to turn a wheel in the vicinity, a great point is at once made of "the natural advantages;" and the public are led to hope for cheap electricity as a consequence. Yet the London Electric Lighting Companies, with their works on the banks of a large tidal river, prefer to trust to coal and steam. It has also been stated that the cost of utilizing the natural advantages of Niagara as a source of power, is greater per horse-power than that of providing steam for the cotton mills of Lancashire. But if practical operations are commenced, the first item is an engine and boiler house. When it comes to the question of the practical value of the lights, the small end of their mental telescope is invariably directed towards electricity, while the large one is used for gas. They appear to believe that an 8-candle power electric lamp is equal in practical effect to an ordinary flat-flame gas-burner, though three or four times as many such lamps are required to get the same lighting effect. I have seen a shop that was formerly lighted by six Welsbach burners, illuminated by twenty such lamps, and do not think that any independent observer could pronounce the light to be improved. Another common delusion is that a rusty and badly gone iron union jet is a fair sample of the lighting appliances at present available for the use of gas consumers. There is reason to be thankful that there are no residuals in the generation of electricity. If there was anything corresponding to coke, tar, and ammonia, the public would be regaled with rhapsodies on the subjects of cheap fuel, valuable chemicals, and home manures. We are used to the vagaries of electricians by this time, and no harm would be done if the attention of ignorant or ultra-nervous people was not occasionally caught, rendering them quite unable to rest until they have disposed of their gas shares, usually at a price much below the real value of the property. This category includes ladies and elderly persons who are least in a position to lose money; and therefore almost a criminal responsibility attaches to reckless statements that may have a prejudicial effect on any class of investments. The higher the position of the speaker, the greater the necessity for caution. Having all this in view, one need not wonder at the notion of generating electricity from stuff that will not burn. We may next expect to see the old Latin motto altered to: *Ex nihilo*—comes electricity.

But what is the explanation of the known fact that steam is raised at Shoreditch, and that the dustbin refuse is destroyed? Simply that some extraneous source of fuel is available, a portion of which goes to drive out the moisture and heat up the house refuse to a temperature at which the combustible part is consumed, and the remainder to heat the water in the boiler. The financial success, or otherwise, of any destructor system depends not on the ability to do without an extraneous supply of fuel, but on the cost at which that supply can be obtained. We are told there is a coal heap "for emergencies" at Shoreditch. At many other places, the coal heap is in continual requisition; and under such circumstances, the cost of raising steam is greater than if the coal was used in the regular way. When in London a few weeks ago, I was sufficiently curious on these points to take a stroll in the neighbourhood of the works at Shoreditch, and see what material was actually being taken in there. It consisted, not only of ordinary dustbin contents, but also of large quantities of trade refuse—such as sawdust, paper cuttings, &c. —and I was told that manufacturers were not only willing to deliver the stuff at the works at their own cost, but actually paid for its destruction. From this it appears the Shoreditch authorities are in the happy position of being able to secure extraneous fuel for less than nothing—which is a reasonable explanation of their success. Sometimes the supply of trade refuse—which must not be confused with household or dustbin refuse—may be sufficient to render them independent of the coal heap for several days at a time. On Sundays, or at holiday times, the supply may be short; and then coal must be used to keep up the fires. But one can readily understand that, although dustbin refuse is not a combustible in itself, if sandwiched between a load of chips, sawdust, &c., and another of paper cuttings, a different state of things obtains; and if thrown into a suitable furnace, with forced draught at the bottom, the whole may be burnt to ashes, and leave some heat available for the generation of steam in the process.

The number of industries turning out inflammable refuse that is not wanted on the premises is, however, limited; and the Shoreditch district is probably almost unique in being able to secure a supply sufficient to keep the destructors going for days at a time. There are several sawmills in my own neighbourhood, from which sawdust could at one time be had for the fetching. But I am told that it is now worth 10s. or so per ton as fuel for raising steam; and the proprietors do not care to sell it for less. I was therefore surprised to find people paying for its destruction. A destructor could not be run at a profit in Salisbury; so the public should not be left to jump to the conclusion that the Shoreditch results can be repeated anywhere and everywhere, or that it is possible for any municipal authority that chooses to make a profit out of the burning of dustbin refuse. Certainly if the destructors will work efficiently in one place, they will do so in another; but the financial aspect of the question depends very much upon the cost of the extra fuel.

TECHNICAL RECORD.

STEAM, GAS, AND ELECTRICITY AS SOURCES OF ENERGY IN CHEMICAL WORKS.

In the "JOURNAL" for the 14th ult., we briefly noticed a paper on the above subject read by Dr. F. H. BOWMAN, F.R.S.E., &c., before the Manchester Section of the Society of Chemical Industry. The text of the paper is given in the current number of the Society's "Journal," from which we reproduce it.

Power in chemical works does not occupy so important a position as it does in textile industries, where the whole of the transformation is effected by mechanical means. In chemical works it is principally confined to subsidiary operations, such as grinding and pulverizing raw materials, working pumps for the purpose of lifting the various liquids, compressing air or other gases, mechanical furnaces, grinding, centrifugal drying-machines making boxes or barrels, actuating cranes, or in the form of locomotives for haulage in the yards.

In the carrying out of any works with which I have had to do, I have always endeavoured to avoid mechanical operations; and when these were necessary, the machine was made as simple as possible. Chemical works abound in dust, dirt, gases, or liquids which injure machinery, wherein lies the difference between them and a textile factory. It is thus advisable to use the very simplest forms of engine which can stand the rough wear and tear to which they have to be subjected. Chemical works usually cover a large area of ground, and it is not possible to centralize the power, because operations are rarely simultaneous, and often far from one another; and small independent engines have to be relied on.

Even under the best conditions, the steam-engine is a wasteful machine. The source of loss arises in many parts. First of all there is the inefficiency of the boiler itself. The boiler ought to be as simple as possible, because it is usually tended by unskilled labour, has to work night and day, and is more liable to strain by continuous working than if it could be stopped and attended to oftener. In my opinion, there is no boiler equal to the two-flued Lancashire. It is not so efficient as the locomotive type, or even the externally-fired tubular type; but it is the simplest, requires little attention, is easy to clean and repair, and will burn—if the draught is properly regulated and the size of the grate area properly designed—with every kind of fuel. For an internally-fired boiler, in charge of a skilful fireman, hand-firing will meet all the requirements. But in large works it is advisable to have mechanical stoking, because there is the same efficiency at all hours; and this more than compensates for the extra expense of the mechanical stokers, which, moreover, tend to the prevention of smoke, and an increased economy. Mechanical stokers are of two kinds—coking stokers and sprinkling stokers. The coking stokers are fed continuously at the front, and the evolved gases pass over the hot fuel at the back of the grate; and this I have found to be the best where the work is continuous.

The Mactear furnace in the ammonia-soda process, or the salt

pots and furnaces in the Le Blanc process, which require a continuous flame, cannot be worked efficiently if it is necessary to consume all the fuel; and hence, where the works are large enough, it is advisable to mix the unburnt fuel from these furnaces with a small portion of good slack, and then use it for steam raising with a forced draught, either using the fan, or, what is simpler still, the steam-jet properly arranged, which makes the furnace practically into a blacksmith's hearth. A pound of ordinary Lancashire slack or Burgy coal will evaporate from 8 lbs. to 9 lbs. of water, when the boilers are free from scale and the water is sent in at near boiling-point. A Lancashire boiler fitted with an economizer almost equals a tubular one. The latter does more work in the same space; and though it costs more to keep up, it saves expenditure in plant.

With an efficient boiler and first-class engines, the cost of delivering power at the fly-wheel shaft amounts to £10 per indicated horse power, or (say) £5000 for a 500-horse power engine. This includes a moderate price for the area of land upon which the plant stands. An average pound of hydrogenous coal will give about 14,500 heat-units, and about 10,800 of them are delivered as steam to the cylinder. If we allow about 8 per cent. for ash, we may say that 1 lb. of coal will practically yield about 10,000 heat-units. This represents about 7,720,000 foot-pounds of energy; and if this could all be utilized in a steam-engine, the pound of coal would represent roughly 4 indicated horse power working for one hour, which would be about ¼ lb. of coal per indicated horse power per hour. Unfortunately, no steam-engine will accomplish this. The very best marine engines consume about 2 lbs.; while ordinary condensing engines use from 3 lbs. to 3½ lbs. of coal—taking 1 lb. to represent about 9 lbs. of water evaporated. The best triple-expansion engines, measured by the quantity of steam which they use, consume from 12 lbs. to 14 lbs. of steam per indicated horse power per hour. Compound condensing engines use from 15 lbs. to 18 lbs. of water; single-cylinder condensing engines, from 20 lbs. to 25 lbs.; and high-pressure engines, varying with the steam pressure and the size of the engine, from 20 lbs. to 50 lbs. Some of the numerous engines that are found in chemical works doing the pumping under ordinary conditions of open air and other disadvantages, and frequently of very small size, would be found to use even more than this.

If we were to raise steam with 1 lb. of coal with the very best appliances, our results would be something as follows: Loss by imperfect combustion, radiation from the furnace, and heat carried up the chimney, 20 per cent.; heat lost by radiation from the boilers, pipes, cylinders, &c., 2 per cent.; heat carried away into the condenser, or sent out as waste in the exhaust steam, if a high pressure, 63 per cent.; heat converted into indicated horse power in the cylinder, 15 per cent. Now, as we have no engine that will work with 1 lb. of coal per indicated horse power per hour, it means that we cannot at the present moment utilize 85 per cent. of the energy in the coal.

In large chemical works, power has to be distributed over miles of pipes exposed to the condensing action of the air; and hence a very large percentage of inefficiency must be added to that which has already been mentioned. I doubt whether in many of our small engines we actually use 5 per cent. of the power originally in the fuel.

Now comes the question of cost per indicated horse power per annum. From a series of experiments with a compound condensing engine of 500-horse power, the cost of which was, roughly, £5000, the cost came out as follows: Interest on plant, 10 per cent., £500; wages, £160; cleaning and repairing boilers and brickwork, £90; oil, grease, boiler composition, &c., £80; repairs, and keeping up of engine, including packing, £100; rates, taxes, and insurance, £100; sundries, £50—total, £1080. The boilers were Lancashire two-flued boilers working at 100 lbs. pressure, which is as high as I should recommend for chemical works. The boilers were 8 feet in diameter and 30 feet long, with five tubes in each flue, and a set of two of Green's economizers. This gave for power, without water or fuel, about £2 3s. 3d. per indicated horse power per annum. The coal was good slack, 6s. 8d. per ton, delivered on the firing-floor; and the amount of coal consumed, including banking and other purposes connected with the power, but not including the heating of the works, which was supplied from a separate boiler, gave 4·5 lbs. of coal per indicated horse power per hour. The ashes and banking represented about ½ lb.; so that the efficiency of the engine was about 4 lbs. per horse power. The coal cost about £2 per indicated horse power per annum; making a total cost of £4 3s. 3d. This is about ½d. per indicated horse power per hour on a working week of 56½ hours per week, and 50 weeks per annum. The engine under test conditions gave less than 2·83 lbs. of coal per indicated horse power per hour, measured by the actual steam used, as calculated from the indicator diagram; but the tests were taken of the cost based on five years' working. This was running the ordinary factory hours; and in chemical works where 24 hours are worked, there is not the banking to take into account. But I very much doubt whether an equivalent of steam delivered to the engines of any chemical works costs less than this.

Steam is not a good vehicle for obtaining power, because it can never be a perfect gas unless absolutely dry; and the moment it begins to expand—which it must do if it is worked economically—it ceases to be a dry gas. I thought at one time of using producer gas. I put down producers, but found that to keep up a constant supply of gas it required a series of producers rather than storage space in a gasholder, as this enabled me to equalize the flow, and utilize the heat of the gas at the time of its generation in the producer. I also found that it was useless in two-flued boilers, as a large portion of the efficiency of the boiler arises from radiation from the fuel; whereas the gas-flame was non-luminous, and its efficiency as a steam raiser was greatly reduced. If complete combustion were not attained, and the flame thereby rendered luminous, it deposited on the surface of the boiler enormous quantities of soot, which seriously interfered with the efficiency of the heating surfaces. If the flame was made to impinge on refractory material, such as filling the flues partially with bricks stacked so as to leave interstices between them, the efficiency was increased. But my experiments led me to the conclusion that for the use of gaseous fuel tubular boilers were absolutely essential, so that the whole of the flame might be brought into intimate contact with as large and as thin an absorbing surface as possible.

For ordinary steam-raising, I believe the present method of using solid fuel is far the best and the most economical. Where gas is a bye-product, it practically costs nothing. If gas is to be used as a source of power, we must look for its utilization to the gas-engine; and already in this direction results have been reached which exceed in economy the use of steam. In first-class gas-engines, an indicated horse power has been obtained on a scale with rather less than 1 lb. of coal per hour, which is about 50 per cent. more economical than the best steam-engine. Gas-engines, however, are complicated and intricate; and this renders them unsuitable for chemical works, though if kept in a separate building, and worked with a mixture of water gas and producer gas, I believe they might come in at far less than the cost of steam. On the other hand, in nearly every part of a chemical works steam is required for purposes other than power, and the pipes that convey the steam can readily be drawn on for it. For power alone, the gas-engine is a most efficient machine, more especially for the production of electric current. I myself have obtained power in this way at less than half the cost of steam; and with a 200 or 300 horse power plant, it is possible to produce an indicated horse power at a cost of not more than 30s. per annum. The cost of a gas plant and engines complete may be taken at about £12 per indicated horse power, so that the original cost is about 20 per cent. dearer than a steam plant. But it is 50 per cent. more efficient; so that the first cost need not be considered. Thus a 500-horse power plant for steam being £5000, a similar gas plant would be £6000. But a saving of only £2 per horse power per annum would repay the extra outlay in twelve months, and represent a saving of £1000 a year for ever afterwards. This is quite as low as any figures I have been able to obtain with regard to water power, either in England or on the Continent. We have so little water power in this country that it is hardly necessary to discuss its merits; but it becomes an item to be taken into calculation when electrical processes are to be used, and power becomes a considerable item. I understand that in Germany an indicated horse power can be produced by water at 60 marks (£3) a year; and in some other parts of the Continent and in America at £2. But water power is often distant from the centre of distribution, and also from places where coal can be obtained; and thus the cheapness of the power is more than balanced by the increased cost of fuel and carriage.

In chemical works, electrical distribution is almost impossible. Dust and gases have great effect on conducting wires and electric motors. I have used lead-covered wires with a coating outside, and yet they were eaten through in a short time; and, except where motors can be enclosed in special rooms or boxes, and conducting wires kept out of reach of corrosion, electrical distribution of power is not suitable for such works. With electric chemical processes, the conditions are different; but I shall not deal with them now. Electrical distribution can best be applied in chemical works to lighting. You can obtain at least twice the quantity of light by the arc lamp than by burning gas or even Wells lights. To compete with steam as a motive power, electricity must be supplied at not more than ¼d. per Board of Trade unit, or half this cost to compete with gas.

THE REW CARBURETTED WATER-GAS PROCESS.

A few years ago we referred in the editorial columns to a proposal made to the Chicago Board of Aldermen to introduce into the city a process devised by Mr. H. C. Rew for the production of carburetted water gas. The process has been thoroughly tested of late at the works of the Missouri Gas Company in Kansas City, by Mr. F. L. Garrison, Assoc.M.Am.Soc.C.E., in conjunction with Mr. E. E. Morrell, the Engineer of the National Gas and Water Company, of Chicago, who are exploiting the system. A copy of Mr. Garrison's report has been forwarded to us; and we give some extracts from it, in order that readers may be in a position to judge how far the claims made for the process are justified.

Mr. Garrison states at the outset that the thermo-chemical reactions taking place in the working of the Rew apparatus may be divided into four groups: (1) The formation of ordinary coal gas by the destructive distillation of bituminous coal in the coking chamber, the result being a large body of coke; (2) the formation of a highly combustible producer gas from the coal

and coke, by the action of a regulated hot or cold air-blast; (3) the creation of water gas by the action of steam upon incandescent coke in the generator; and (4) the addition of carbonaceous material in the form of a heavy mineral oil to increase the luminosity of the water gas. The author disregards the first and fourth groups; the reactions in the former being comparatively simple, while those in the latter were too complicated for investigation in the time at his disposal.

Dealing with the second series of reactions, he says the aim is to produce a gas containing 34·3 per cent. of carbonic oxide and 65·7 per cent. of nitrogen—that is, to consume all the oxygen of the blast in making carbonic oxide, the nitrogen being necessarily inert. Mr. Garrison examined the published analyses of ordinary producer gas from a large number of sources and a variety of apparatus, and found that Akerman had given certain figures as representing typical compositions of producer gas when steam is not used. These will be found below in conjunction with the average of four analyses of gas taken from the middle of the generator of the Rew apparatus, about four to six minutes after the air-blast had been turned on:—

	Akerman. Per Cent.		Rew Apparatus. Per Cent.
CO_2	3·6 to 11·9	..	5·217
C_2H_2	0·2 „ 0·7	..	0·267
CO	24·1 „ 32·0	..	24·126
CH_4	1·9 „ 3·1	..	4·513
O_2	— —	..	0·404
H_2	0·5 „ 0·8	..	4 016
N_2	60·0 „ 62·0	..	61·372

Mr. Garrison calls attention to the fact that in the average composition of the Rew gas the carbonic acid is quite within the bounds of the results obtained in the best practice with the generators specially designed and operated to obtain producer or fuel gas. The same with the marsh gas and the nitrogen; while the amount of oxygen present is so small that it may be ignored. The carbonic oxide does not exceed the limits specified in the first group, and is just about equal to the lowest given by Akerman. The comparatively large proportion of marsh gas is derived from the destructive distillation of the coal in the coking chamber. The percentage of hydrogen is small in comparison with the producer gas made in apparatus using steam, and large as compared with Akerman's results. Its comparative abundance is attributed to the presence of some steam or hydrogen from the preceding "run." Mr. Garrison says the results obtained in the stage of operation of the Rew apparatus when a fuel or producer gas is desired closely approximate the best practice in forms of apparatus particularly designed to generate a highly combustible gas. In this particular the Rew plant far exceeded his expectations; and he considers the results as indicated by his analyses rather remarkable. The samples of the gas analyzed were taken at intervals of several days, and not at any particular hour or stage of a day's operation. The author is of opinion that there is room for improvement in the disposition of the air-blast throughout the Rew apparatus.

Passing to the production of water gas, Mr. Garrison remarks that the chemical reactions taking place when steam is introduced into the incandescent coke immediately after blowing up are comparatively simple. In good practice, the aim is to convert the carbonic acid, which in turn is reduced to carbonic oxide; thereby effecting a great saving of heat. In this reaction, heat is necessarily absorbed. The calorific power of hydrogen is 29,162 when obtained from the decomposition of water in the form of steam—that is, the incandescent coke must give up this number of heat-units to decompose a unit of water. Carbon, however, when burnt to carbonic acid, develops 8080 units. Hence in the above reaction we have 40,244 units. When the temperature of the coke is not above 500° C., this reaction is complete; and as the carbonic acid thus formed ascends into the hotter portions of the heated mass of coke (considering now only the steam introduced at the base of the generator), the reaction $CO_2 + C = 2\,CO$ ensues—being almost complete at 1000° C. This reaction also absorbs heat. In the production of water gas, according to theory, 4806 units should be added to the 40,244 units required to decompose the steam; making a total of 45,050 units. As far as the gas itself is concerned, Mr. Garrison is of opinion that we have a comparatively simple problem; but he says we know absolutely nothing of the initial products derived from the oil, and of the interaction taking place between these gases and the water gas. Until this thermo-chemical problem has been solved, he is perfectly sure it will be impossible to estimate the quantity and quality of the so called carburetted water gas theoretically obtainable from a given amount of fuel, steam, and oil. With regard to the decomposition of steam in the Rew generator, he says the results he obtained were not so good as they should have been. The steam was wet, the pipes conveying it from the boilers were not wrapped, the pressure was low (about 80 lbs. instead of 150 lbs.), and he thinks too much steam was used. He gives the results of six analyses he made of the final carburetted water gas; the average being as follows:—

	Per Cent.
CO_2	5·1
C_2H_4	13·6
CO	17·9
CH_4	27·5
O_2	0·1
H_2	29·6
N_2	6·2

Average illuminating power, 22 35 candles.

In the three days from March 22 to 24, 1897, 1,442,000 cubic feet of gas were produced with the consumption of 66,156 lbs. of coal (less 10,634 lbs. of ash, 55,522 lbs. net) and 6910 gallons of oil. In other words, 1000 cubic feet of gas required 45·9 lbs. of coal and 4·79 gallons of oil. The coal used was presumably all from Huntington, Arkansas; and the potential energy of the gas yielded was calculated at 165,673 calories per cubic foot, to make which required 0·0459 lb. of coal and 0·00479 gallon of oil. Theoretically, this amount of coal and oil should furnish 323,600 instead of 165,673 heat-units; consequently, 157,927 units were lost in producing the gas. The ratio of the energy in the finished product to that in the raw material used was 51·2 per cent. Lowe gas of about the same composition and illuminating power as that tested at Kansas requires for its production 50 lbs. of coal or coke and 4·75 gallons of crude Lima oil per 1000 cubic feet. Allowing 4 lbs. of coal for steam purposes, pretty much the same results are arrived at with the Lowe and the Rew system. By attaching a rotary fan to the main leading from the scrubber to the relief holder, and operating it during the "run" period through 24 hours, the result arrived at was that 36·8 lbs. of coal and 5 gallons of oil were required to produce 1000 cubic feet of gas, the composition of which showed little change from that made without the assistance of the fan. From March 26 to March 29, there was a make of 2,361,000 cubic feet of gas from 101,332 lbs. of coal and 10,730 gallons of oil, or at the rate of 42·9 lbs. of coal and 4·54 gallons of oil per 1000 cubic feet. This, in the author's opinion, surpassed the best results claimed for the Lowe apparatus. During this period, four tests of the gas were made; and they showed that it had an average illuminating power of 24·18 candles. One analysis was made for calorific efficiency; and it was found to be 56·12 per cent.

Mr. Garrison concludes his report with a comparison of the Rew and Lowe processes for making carburetted water gas.* He claims for the Rew system that, even when the apparatus is not well managed, it ensures by no means discreditable results as compared with those obtained with the majority of Lowe plants. He is of opinion, however, that they would be better with the exercise of greater care and skill. He indicates the lines on which he thinks improvements might be made. As far as the heat intensities and thermo-chemical reactions are concerned, he says the problem is but half solved, and until a careful study is made of the oil gases, we shall be very much in the dark as to what actually takes place in the superheater during a "run." His opinion is that the whole subject is capable of being reduced to a strictly scientific plane, and the apparatus—in fact, the entire plant—operated in a most intelligent and economical manner.

Improved Railway Carriage Lighting by Gas.—During the past few years considerable improvement has been effected in the gas lighting of some of the carriages running on the underground railways of London. A further achievement in this direction may be seen in a train put on by the Metropolitan Company, in which first-class compartments are illuminated with four jets arranged in two groups, while one pair of burners is allowed to each second and third class compartment. A larger supply of gas appears to be provided; and the lights, which are on the Pintsch system, are stated to be of 16-candle power each.

Professor Smithells on the Use of Coal Gas and Acetylene.—Writing to one of the Leeds papers with respect to an inaccurate paragraph which had appeared therein, from which it might be inferred that Professor Smithells holds opinions unfavourable to the employment of coal gas as a heating agent and of acetylene as an illuminant, he states, with regard to the former, that he is anxious to see the use of coal gas for cooking and heating greatly extended; and the only caution that he feels it necessary to add is that gas-stoves, like coal-stoves, should be supplied with a flue to take away the products of combustion, and that the gas should be properly lighted. Some experiments made in the Yorkshire College, by Dr. Cohen, have shown that the prejudice against gas-stoves, except that portion which is a matter of taste or sentiment, is entirely unjust. As to acetylene, he says the dangers attending its use have been greatly exaggerated. This arises almost entirely from two causes—first, the "gross carelessness of ignorant would-be inventors;" and, secondly, the "reckless use of liquefied acetylene." He admits that the use of liquid acetylene or of the gas in the pure state under more than twice the atmospheric pressure is undoubtedly dangerous; but he is not aware that anyone is now advocating its use in this state in England. The employment of acetylene under low pressures is accompanied by dangers which to a large extent are exactly the same in kind as those connected with coal gas, though somewhat greater in degree. Professor Smithells points out that acetylene is yet in its infancy as an illuminant, and is passing through its time of trial, as did coal gas when first introduced. But he is bound to acknowledge that the people most interested in its commercial development in this country seem taking every possible precaution to ensure that its use shall be rendered safe, quite apart from the intervention of the Government, who, by an Order in Council, have fixed the pressure limit at 100 inches of water.

* Mr. Rew's apparatus was described in the "JOURNAL," Vol. LII., p. 897, and Vol. LX., p. 815.

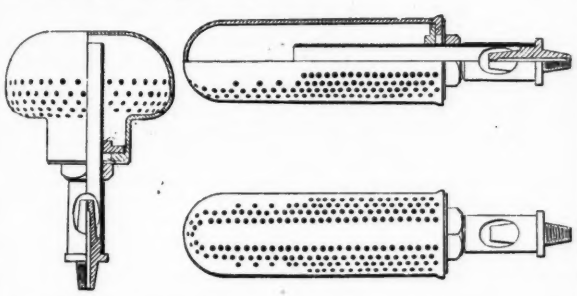
REGISTER OF PATENTS.

Gas-Engines.—Wimshurst, J. E., of Billiter Buildings, E.C. No. 1011; Jan. 14, 1897.

This engine is constructed essentially as follows: Within a drum-shaped cylinder, and upon a shaft passing centrally through the sides of the drum, or upon a sleeve upon the shaft (so as to be able to rotate or partially rotate within the drum), there are mounted two vanes or paddles fitting closely to the sides and internal periphery of the drum. The vanes are arranged radially and diagonally on opposite sides of the shaft or other centre of rotation. Centrally mounted in the drum is arranged a second pair of vanes similarly placed on opposite sides of the centre of rotation. The shafts or sleeves, or other parts to which the two pairs of vanes are connected, are passed through stuffing boxes or bearings outside the sides of the drum; and, by cranks or other devices connected with the vanes, the movements of the vanes are transmitted to a cranked countershaft, to which rotary movement is to be imparted. The shaft and the connecting-rods are so arranged that each vane passes through substantially a right angle. The vanes, thus arranged and connected, constitute four pairs of bellows within the cylindrical drum; and this arrangement of apparatus is thus suitable for four-cycle engines of the type now being made. The cycle would be: (1) Intake of explosive mixture; (2) compression of same; (3) explosion; (4) discharge of waste gases.

Atmospheric Gas-Burners.—Solon, M. F., of Burslem, Bibero, M., of Manchester, and Bailey, J. C., of Burslem. No. 1393; Jan. 19, 1897.

This invention has for its object to regenerate the gaseous mixture used in the heating burner previous to ignition; and it consists in making the burner in the form of a "muffle" or chamber, with holes, slits, or other orifices through which the mixture issues and burns around the "muffle," and so heats it to a high temperature, and which in turn acts as a regenerating surface for the oncoming mixture inside the muffle. The orifices are at the lowest portion of the muffle, and so arranged as to cause the flame to partly or wholly envelop the muffle.



The gas may be supplied to the muffle on the bunsen system; care being taken that the mixture of air and gas is conveyed well into the muffle, so that the gas has to travel over the largest amount of surface before reaching the burning orifice. Or the muffle may be made with a mixing-tube rising to near the top of the muffle, and the gas may be supplied by a plain pipe opening into the mixing-tube; the heat of the muffle and mixing-tube inducing the air to enter as an upward current.

A vertical form of the burner is shown; also a side and bottom view for a horizontal burner.

Gas-Engines.—Hunter, J. W., of Lewisham. No. 1402; Jan. 19, 1897.

The body of this engine consists of a central drum or casing in which the cranks revolve, and having projecting on opposite sides of its circumference a cylinder fitted with a piston attached by a connecting-rod with a crank-shaft. The projecting cylinders may either be in line with each other, or set-off so as to bring each piston in line with its own crank. The cranks are either placed diametrically opposite to each other, or slightly inclined therefrom; the former position being preferred. The engine thus consists of two cylinders opposite to one another, and acting simultaneously on a double-throw crank. The cylinders, though they may be regarded as independent, are not so; as they are connected at their outer ends by passages with a central valve-box, open to both. They thus act as one cylinder with two pistons; the outer end of each piston receiving the impulse at the same time. An essential feature of the invention is that there is no compression space or combustion chamber in either cylinder; the cylinder ends being as close as possible to the pistons when at the outward end of their stroke. The requisite space for compression and combustion is placed quite outside the cylinders proper, and is provided for in the passages which connect the two cylinders with the central valve-box. This also acts as part of the compression space, and where the charge is most conveniently fired. The result is that a large proportion of the heat resulting from the explosions is generated in the channels and their connections, and is quickly dissipated by radiation; the cylinders and their working parts being thus kept comparatively cool. Advantage is taken of the reciprocating movement of the pistons, by the application of inlet and outlet valves, to convert the closed drum in which the cranks revolve into an air-pump; and the air so acted on is forced through spiral or other channels, formed by cased-in ribs or projections on the outer surface of the cylinders. A large quantity of cool air is thus positively forced over the outer surfaces of the cylinders and the ribs attached to them, which arrangement, together with that for effecting the combustion outside the cylinders proper, renders the motor, to a large extent, self-cooling.

Explosion-Engines.—Winton, A., of Cleveland, Ohio, U.S.A. No. 1598; Jan. 20, 1897.

This invention in explosive engines mainly relates to that type in which hydrocarbon liquid is employed. It pertains to an automatic governor for regulating the admission of air and gas, and to automatic means for shutting off the flow of the hydrocarbon liquid, except when the cylinder of the engine is being charged.

One object aimed at is to provide a very sensitive and reliable governor for regulating the amount of the explosive mixture which is permitted to pass into the cylinder, according to the speed of the engine, and hence according to the working resistance or load on the engine. Another object is to provide means for shutting off completely the flow of hydrocarbon liquid, except when the cylinder is being charged, and to relatively regulate the amount of air and hydrocarbon fed at each charge, whereby the quality of the charge remains practically the same whether the charge be large or small. The invention also pertains to a governor and hydrocarbon feeding device for four-cycle system explosive engines, whereby the governor will regulate not only the amount and quality of charge admitted to each cylinder, but should the load of the engine be light, it will control the charging-valves so that only one cylinder will be in operation.

Rotary Water-Meter.—Lühne, J., of Aix-la-Chapelle. No. 16,765; July 15, 1897.

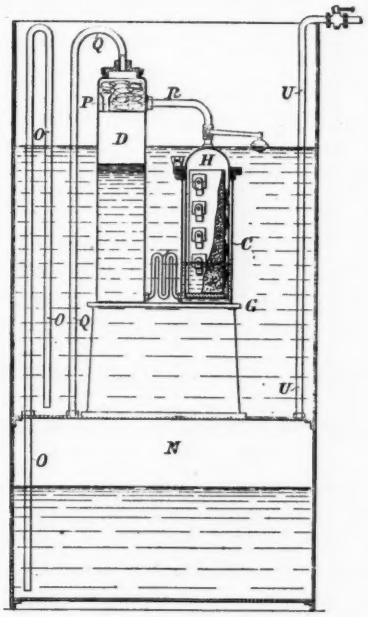
The object of the inventor is to utilize the rotation of a wheel having a number of radial projections or fans attached to a central boss, to indicate the quantity of fluid passing through a closed conduit; the axle of the fan-wheel being connected with any suitable counting mechanism. The operation of the arrangement is such that it becomes impossible for the counter to register a greater quantity than that actually used, "even if the greatest variations of pressure and the most violent shocks take place in the conduit." The apparatus is characterized by the fact that the dimensions and angles of the admission and outflow openings for the fluid are the same, whether the openings are separated by a central partition, or whether a special mode of regulation influences the direction of the flow.

Electrically Igniting Distant Gas-Lamps.—Klinger, W., of Berlin. No. 23,310. Oct. 11, 1897.

The principle of this invention consists in the employment of one flow and return circuit only, by means of which it is possible from one point to open the valve or cock belonging to each gas-burner, and to ignite the gas issuing therefrom. The aim is to localize the difficulty of insulating induced currents; for the reason that, when employing an induction coil, the induction currents of which are sent into the circuit, only a small number of the gas-flames can be simultaneously ignited. Moreover, a greater length of spark must be obtained from the induction-coil in proportion to the number of burners to be simultaneously lighted. Such sparks, however, the patentee points out, are only obtained from currents of high intensity, whereby it is scarcely possible to insulate the gas service and lamps from intense currents. The patentee therefore introduces into a circuit, in which the primary coils of an optional number of induction coils are situated, an electro-magnet, the armature of which, during the passage of the current through the coils of the electro-magnet, actuates two contact springs in such manner that an electric current can pass from one spring to the other, which effects a shunt, with no resistance to the coils, and causes them to lose their current. The armature, however, after the disappearance of the magnetism in the electro-magnet, and in consequence of its inertia, maintains its movement for a short time, and, by separating the springs, opens the entire circuit, from which, as already mentioned, the resistance of the coils of the electro-magnet had been switched out. The armature now returns to its former position; and the operations are repeated until the circuit is held closed by any contact mechanism.

Manufacture of Acetylene.—Boult, A. J.; a communication from F. Alexandre, of Paris. No. 26,325; Nov. 11, 1897.

The generator is arranged in the upper compartment of a gasholder, so as to cause it to work in combination with the holder. It is made in two separate parts—the generator proper C and the reservoir D, for the liquid producing the decomposition of the carbide of calcium.



The generator comprises an outer cylinder or vessel, in which is arranged another cylinder or vessel serving as a jacket, and a third (inner) cylinder or vessel which contains the charge of carbide of calcium.

This latter cylinder rests on the porous bottom G of the intermediate cylinder, and forms a bell H for the gas generated. The inner vessel is provided with holes at different heights on its circumference, and closed by porous plates held by plates secured on the inner cylinder, and each provided with a hole corresponding to the holes of the cylinder.

The reservoir D, containing the water for the generator C, communicates with the latter by a syphon-tube. At the upper part of the reservoir, there is a chamber, the bottom of which is provided with a funnel P enabling the reservoir to be filled. The cover is an air-tight screw-plug, to which is connected a pipe Q, through which the gas is conducted into the bottom compartment N of the holder. The chamber above D is filled with absorbent material—such, for instance, as sponge—for the purpose of drying the gas entering, and passing through it from a pipe R connected at the other side to the bell H of the generator. A cock with a float attached is fitted to the pipe R between the bell and the drying chamber.

A syphon-pipe O places the upper and lower compartments of the holder in communication—enabling water to pass from one to the other under the pressure of the gas generated. The lower compartment communicates besides with the outside by means of a pipe U.

The working of the apparatus is as follows: The water from the reservoir D enters the generator C, and rises in the empty space between the first and second vessels. Owing to the porosity of the bottom-plate G, moisture passes to the inner vessel, and arriving at the first porous plate, passes through it, and comes in contact with the calcium carbide adjacent to it. The acetylene generated immediately rises in the bell H, passes through the valve which is open at the moment, as the level of water in the top compartment of the holder is not sufficiently high to raise the float, and through the pipe R, whence it enters the drying chamber, and is led by the pipe Q into the lower compartment of the holder. As the gas is generated, and as its pressure in the lower compartment of the holder increases, water from this compartment is forced through O into the upper compartment of the holder, thereby raising the float of the valve until the latter is closed. At this moment, the gas which is still issuing from the inner vessel into the bell H attains a pressure greater than the head of water in the reservoir D, and sufficient to force the water into the reservoir, in which, as well as in both the compartments of the holder, the head of water is calculated to attain the working described. The carbide of calcium being no longer exposed to moisture, the production of gas ceases until (owing to the consumption or drawing off of the gas through the pipe U) the pressure of gas in the lower compartment of the holder decreases, and no longer balancing the water in the upper compartment enables a supply of water to re-enter the former compartment, and cause the lowering of the float of the valve and the opening of the latter.

APPLICATIONS FOR LETTERS PATENT.

602.—Clark, A. M., "Production of acetylene gas." A communication from H. Heimann and Co. Jan. 8.

626.—Fleming, E., and Smith, F., "Gas-engines." Jan. 10.

643.—Dunham, W., "Method of setting out curved trenches for gas and water main pipes, and making connections to other mains." Jan. 10.

651.—Trewin, A., "Protector for incandescent gas mantles." Jan. 10.

686.—Bertheau, H. A., "Gas and petroleum engines." Jan. 10.

691.—Tabard, G., "Gas pressure regulators." Jan. 10.

692.—Botley, C. F., and Cutler, S., jun., "Oil-injector for water-gas carburetters." Jan. 10.

694.—Jousset, C., "Generators and lamps for the production and use of acetylene gas." Jan. 10.

743.—Newey, H. E., "Lamps and generators for acetylene gas." Jan. 11.

745.—Legge, J. St. Clair, and Cooper, A. S., "Gas-burner used for acetylene gas and the like." Jan. 11.

786.—Warne, W. T., "Automatically shutting off the supply of gas; also applicable for preventing loss or waste of valuable fluids in case of fire." Jan. 11.

793.—Keysser, A., "Incandescent gas-lamps." Jan. 11.

872.—Thornton, J. E., and Lea, J. P., "Internal combustion engines." Jan. 12.

891.—Richardson, S. T., and Price, R., "Generators and lamps for acetylene gas." Jan. 12.

896.—Holmes, G., "Gloves for gas workers." Jan. 12.

922.—Graham, H. B., "Internal combustion engines." Jan. 12.

930.—Lothammer, F. J., "High-pressure steam and gas generators." Jan. 12.

934.—Brouwer, J. de, "Charging gas-retorts." Jan. 12.

947.—Robinson, J. V., "Burners for acetylene gas." Jan. 13.

1005.—O'Brien, J. O., of the firm of W. P. Thompson and Co., "Producing acetylene gas." A communication from P. P. H. Macé and De Burgue. Jan. 13.

1013.—Bournonville, E., "Acetylene gas generators." Jan. 13.

1045.—Stratford, J., "Gas-meter index altered for official testing." Jan. 14.

1054.—Legge, J. St. Clair, and Cooper, A. S., "Acetylene-gas burner." Jan. 14.

1096.—Chauvin, R. F. O., and Arnoux, R., "Explosion engine." Jan. 14.

1107.—Grabham, A., "Silencing the valves of internal combustion engines." Jan. 14.

1123.—Pomes, R., "Acetylene lamps." Jan. 14.

1128.—Jolles, M. H., "Carburator for air gas automatic apparatus." Jan. 14.

1134.—Thomson, J., "Water-meters." Jan. 14.

1148.—Parker, G. E., "A new, or improvement on any existing, water-gas lamp, for every lighting or heating purpose, and the special cartridge or generator for same." Jan. 15.

1154.—Drummond, J., jun., "Acetylene gas generator and holder." Jan. 15.

1158.—Sprott, R. E., "Use of calcium carbide in the production of acetylene gas." Jan. 15.

1168.—Fröhlich, B., "Incandescent gas-lamps." Jan. 15.

1188.—Cameron, D., Commin, F. J., and Martin, A. J., "Generation of gas for lighting, heating, and power purposes from sewage or other decaying organic matter." Jan. 15.

CORRESPONDENCE.

[*We are not responsible for the opinions expressed by correspondents.*]

The Use of Breeze as Boiler Fuel.

Sir,—From what has appeared in your "Correspondence" columns, it would seem that the particulars you have published on breeze burning were a revelation of something which had never hitherto been attained; but in view of the fact that our well-known dust-fuel furnace has been in use in some of the largest gas-works in the country for six or eight years, it is evident that some people have not been very much awake. In reply to your correspondent's query as to damage to steel plates, we may say that having now fitted nearly 6000 of these furnaces, most of them being for modern boilers made of these plates, no damage has accrued, or is likely to do so, from the application of our system. Many hundreds of the above-named boilers being under the constant supervision of the boiler insurance companies, mostly the Vulcan, your correspondent may feel perfectly safe in adopting the same.

Manchester, Jan. 21, 1898. Meldrum Bros.

Another correspondent writes: The question raised by "C. E." in your last issue is in some measure answered by Herr Haymann of the Nuremburg Gas-Works, in the paper of which an abstract translation appeared in the "Journal" for March 23, 1897 (p. 654). He stated that the boiler to which a Kudlicz grate had been fitted, and used for 151 days, was at the end of that period officially inspected, and no change in the condition of the boiler was observed since the preceding official inspection 607 days earlier. He added that the boiler was injured to no greater extent with the Kudlicz grate than by the use of the ordinary grate. The material of the boiler-plates is not named. Stress has been laid in other papers on the point that the Kudlicz grate does not produce "tongues" or "points" of flame which might cause injury to the plates.

LEGAL INTELLIGENCE.

Defective Meter Registration at Bristol.

In the Bristol County Court, a few days since, before Judge Austin, Mr. T. K. Bibbing sued the Bristol Gas Company for 7s. 8d., which he alleged he had been overcharged. Some months ago, plaintiff informed the Company that he was dissatisfied with his meter. They therefore offered to have it tested, provided he would pay the expense if it should prove to be correct; but this he declined to do. Eventually it was found that the meter was working slowly, and gradually stopping; and then the Company changed it on their own account. They charged Mr. Bibbing, who had kept a record of his meter registrations extending over some years, a very reasonable computation for the time, amounting only to about 5d. per week; he having admitted that he did his cooking by gas. He paid the money under protest; contending that, after his notification to the Company, he was only liable for the quantity of gas registered by the meter. The Judge held that the plaintiff was entitled to a verdict. He had told the Company that he thought his meter was going wrong; and as they did not change it when requested, they were bound by its registration. He gave judgment for the amount claimed, with costs.

The Charge for Water for Public Purposes at Ventnor.

A difference of opinion has for some little time existed between the Ventnor District Council and the Gas and Water Company as to the price to be paid by the former for water used for public purposes. Being unable to agree, the Council summoned the Company before the County Justices in order to have the matter settled; and the case was heard last Wednesday. Mr. Damant, who appeared for the Council, said they would use a million gallons of water per annum, and he thought the supply should be aggregated, and charged at a uniform rate. At present, instead of paying on the basis of the quantity he had named, they were called upon to pay on that of 250,000 gallons. Mr. Wooldridge, for the Company, remarked that they were willing to treat with the Council for a supply in bulk. Mr. G. F. Ingram said the Council were charged on the low levels nothing under 1s. 5d., and on the high levels nothing under 1s. 6d., instead of 7d. per 1000 gallons. Mr. E. H. Stevenson, M.Inst.C.E., said there should be no difference in the charge made in the two districts, which were really one consumer. No large reservoirs were needed, and no pumping was necessary except for the high levels. He thought if the Council paid, at the rate of 7d. per 1000 gallons for the whole of the district, neither party would be hurt. Mr. Wooldridge said it was difficult for the Bench to settle a matter of this kind. The pumped water involved extra labour and cost of materials; and he admitted that the Company had put on 25 per cent. to cover the expense. Mr. J. S. Ineson, the Company's Secretary and Manager, said they had done everything they possibly could to settle the matter. He had communicated with other companies with a view to obtaining their charges. The cost of pumping was 6d. per 1000 gallons, which included rates and taxes, and establishment charges generally as well as interest on capital. Mr. F. W. B. Waterworth, the Borough Surveyor of Newport, said the Corporation of that town charged 1s. per 1000 gallons up to a million for supplying Parkhurst Prison, and 9d. per 1000 gallons beyond that limit. The Barracks were supplied at between 1s. 2d. and 1s. 3d. per 1000 gallons. Mr. W. Matthews, M.Inst.C.E., the Water Engineer to the Southampton Corporation, said he regarded the Company's scale, not only in itself, but in comparison with others throughout the country as a reasonable one. The minimum charge of 7d. per 1000 gallons was exceedingly small, as was also the charge of 25 per cent. additional for pumping. He did not think they could fairly reduce their rates. In his opinion, water could not be pumped and distributed for less than 5d. per 1000 gallons. At Southampton, they bought water from the South Hants Water Company, for sprinkling the roads and flushing the sewers, at the rate of 8d. per 1000 gallons, and they took 4¼ million gallons. The London and South-Western Railway Company were supplied with 165 million gallons at 8d. per 1000; and the Company had

never complained of the charge. The Bench came to the conclusion to fix the price at 7½d. per 1000 gallons for the whole of the district, with a minimum supply of a million gallons; and they directed that each of the parties should pay their own costs.

The Liverpool Corporation and the Water Supply of Prescot.

At the Prescot Petty Sessions last Tuesday, an important case affecting the liability of the Liverpool Corporation in the matter of the water supply of the town came on for hearing. Philip Brady, a working man, applied for an order against the Liverpool Corporation, that they, being undertakers within the meaning of the Water-Works Clauses Act, 1847, the Liverpool Corporation Act, 1866, and the Liverpool Corporation Act, 1880, did unlawfully neglect from March 29 to Nov. 16 last—233 days in all—to furnish him at his residence, 6, Hill Street, Prescot, his water-rate being paid, with such supply of water as he was entitled to. Plaintiff claimed £466, or 40s. for every day of such neglect; this being the amount mentioned in the general section of the Act of 1847. Mr. Collingwood Hope, for the plaintiff, said the case was one that had been before the Court in April last year; and the Corporation were then convicted for neglecting to give plaintiff a constant supply—a penalty of 20s. and costs being imposed. The Corporation appealed; and the Divisional Court confirmed the decision of the Magistrates.* Subsequently some correspondence took place between plaintiff's Solicitors and the Town Clerk of Liverpool; the former stating that unless he received a constant supply of water proceedings would be taken. Ultimately the Town Clerk replied that the matter had been considered by the Water Committee; and they had instructed their Engineer to take the necessary steps to ensure a constant supply to the premises. The next day, Nov. 17, the supply was constant; and it had been so since. Plaintiff, Counsel contended, was justified in claiming the amount named; for he was entitled to a constant supply. On the 233 days mentioned, the supply had been altogether inadequate. The plaintiff, in his evidence, stated that, during the period named, the water used to be turned off between 6 p.m. and 6 a.m. On Saturdays and Sundays, it was off for a longer time. Cross-examined by Mr. Swift, for the Corporation, plaintiff said his rent was 2s. 3d. a week. He paid the water-rate (2s. 8d. a year) in the rent. Mr. Swift: Now, who put you up to all this? Witness: I decline to answer. For the defence, Mr. Swift submitted that the claim was altogether wrongly conceived. It was not a civil debt within the meaning of the Act; and he, therefore, asked the Bench to dismiss the case. The Bench considered that this was not a civil debt; and Mr. Swift's objection was sustained. They, however, agreed to state a case. Another summons issued on similar grounds was withdrawn.

Incandescent Gas Lighting in the Crystal Palace Gas Company's District.—The Croydon Corporation have accepted an offer from the Crystal Palace Gas Company to furnish incandescent burners to the lamps in the portion of the borough they supply, upon the following terms: The Corporation to pay 15s. 9d. for making the required alteration to each lamp in the district so lighted; and then a payment while the incandescent lamps are used of £3 7s. net per lamp per annum, subject to a reduction in the event of the price of gas being reduced. There are in the Norwood Division of the borough (which is the part within the Company's area) about 500 lamps; and the understanding is that a minimum of 200 lamps are to be altered. The cost works out to about 6d. per lamp less than the Corporation have to pay the Croydon Company for the incandescent lamps in their district.

Gas and Water at Fires.—About the middle of last month, an influential Committee was appointed to consider and report upon the recent serious fire in the neighbourhood of Jewin Street; and they made known last week the result of their deliberations, at a meeting of the ratepayers of the wards of Cripplegate Within and Without presided over by Sir H. E. Knight. The question of shutting off the supply of gas at fires had been before the Committee; and they reported on this matter that they had made inquiries of The Gaslight and Coke Company, and were informed that the Company had no valves for shutting off the gas from any particular street or streets in their district; and that in the opinion of their Engineer, the closing of any such valves on the occasion of a fire would be a source of public danger. Thereupon the Committee recommended the meeting to consider whether it was desirable to urge on the Company that a proper and easily accessible stopcock should be placed outside every building, so that the gas could be turned off from it in case of fire. The Committee further recommended the meeting to request the New River Company to provide pressure sufficient to throw water effectually over the highest buildings, and fully charge cisterns for any system of water supply for fire purposes. The report was adopted.

Final Meeting of the Cowes Gas Company.—The shareholders of the Cowes Gas Company have held their final meeting to consider the scheme for the distribution of the assets. The chair was occupied by Mr. F. H. Atkey, who, in proposing that the assets should be employed in discharging the liabilities and costs connected with the winding up of the undertaking, and the remainder distributed among the proprietors in the ratio of £20 for every £10 paid by them for original stock, reported that the result of the arbitration proceedings was that the purchase-money had been fixed at £54,559, including the cost of the Company's Act. He had arrived at the conclusion that Mr. Shiress Will, the Umpire, had valued the concern at £28 2s. 6d. per share. By successful financing with regard to additional expenditure, they had obtained a surplus of £5 17s. 6d. per share, making the total for each share £34. For every £10 of the £9000 recently laid out, the Company had realized by the arbitration £18 2s. 6d. The reason for £20 per share being proposed for distribution was that a claim with regard to the stock had been made on the Company; and though he did not think it was a *bonâ-fide* one, they should keep themselves in a position to meet any demand. The proposition was unanimously agreed to. A cheque for 50 guineas each was presented to Mr. A. Thomas, the Manager, and to Mr. W. Halliday, the Secretary, in recognition of the services they had rendered to the Company, independently of their usual official duties. Thanks were accorded to the Chairman and to the Solicitor (Mr. W. H. Wooldridge) for their successful labours.

* See "JOURNAL," Vol. LXX., p. 1009.

MISCELLANEOUS NEWS.

THE GASLIGHT AND COKE COMPANY.

Half-Yearly Report.

The following is the report to be submitted to the proprietors of the above-named Company at the half-yearly general meeting which will be held on the 4th prox.

The accounts for the past half year show that, after providing for all fixed charges, there remains a balance of £302,483 16s. 9d. The amount required for the dividend at the statutory rate of 12½ per cent., which the Directors recommend to be declared, is £377,003 5s. 3d.; and it will therefore be necessary again to have recourse to the reserve fund to make up the difference—£74,519 8s. 6d.

The abnormally high temperature which was experienced during the whole of the December quarter has affected prejudicially the rate of increase in the sale of gas. The gas sold for the past half year shows an increase of only 2·11 per cent. over the sales of the December half year, 1896; but the increase for the whole year was 906,948,000 cubic feet, or at the rate of 4·51 per cent.

The market for residuals continues to be depressed. The prices for coke and sulphate of ammonia show an improvement when compared with the prices of 1896; but they are still very low, and the receipts for tar products have been less than they have been for many years past.

The number of consumers continues steadily to increase; 17,867 new and additional supplies having been furnished during the past six months. Of these, 14,613 were prepayment meter supplies. These figures afford further evidence of the progress of the Company's business.

During the half year, the Directors offered for sale by auction and tender £25,000 of "A" ordinary stock and £50,000 of 6 per cent. debenture stock. The whole of these amounts were taken up, and realized respectively £306 19s. 2d. per cent. and £209 10s. 10d. per cent. The Directors do not contemplate issuing any further capital during the current half year.

A Bill in Parliament, the object of which is the consolidation and conversion of the several classes of the Company's stocks, has been deposited by the Company for the coming session, and will, in compliance with Standing Orders, be submitted to the proprietors for their approval at a special meeting to be held immediately after the ordinary meeting.

The Court of Directors have been furnished by the several Engineers of the manufacturing and distribution departments with the usual certificates respectively, to the effect that all the Company's plant has been maintained in thorough efficiency.

The accounts accompanying the report will be noticed next week.

CAMBRIDGE UNIVERSITY AND TOWN GAS COMPANY.

The Late Secretary's Defalcations.

The Ordinary Half-Yearly General Meeting of this Company was held last Thursday—Mr. DENNIS ADAMS in the chair.

The Directors in their report recommended dividends at the rates of 10 and 7 per cent. per annum. They stated that, owing to the increase in the business, it had become necessary to enlarge the carbonizing and purifying plant for next winter, the cost of which would be about £10,000. With the view of meeting the extra demand upon the capital, it was proposed to create the balance of the unissued shares at such time or times as the Directors might find necessary. They expressed great regret to have to refer to the defalcations of Mr. William Peed, the former Secretary; and they stated that the vacancy had been filled by the appointment of Mr. A. E. King, Solicitor. The accounts which accompanied the report showed in the reserve fund account items of £111 10s. 6d. interest not invested by Mr. Peed; and in the general balance-sheet the sum of £4500 was put down as being due from him. The Manager (Mr. R. Brown) reported that the amount received from sales of gas, tar, and ammoniacal liquor in the half year ending at Christmas last had in each case been in excess of the corresponding period of the previous year; but, owing to the unusual climatic conditions, coke had realized much lower prices.

The CHAIRMAN moved that the reports be received and entered on the minutes.

Colonel CALDWELL seconded the motion; and it was carried *nem. con.*

The dividends recommended were then declared.

The CHAIRMAN next moved—"That the capital of the Company be augmented by the creation of a sufficient number of shares of the value of £10 each to raise the balance of the authorized share capital; and that the Directors be at liberty to sell such shares at such times and in such proportions as may be deemed expedient." He explained that the steadily increasing demand for gas had brought the Company very near the end of their working powers; and this necessitated the enlargement of the carbonizing and purifying plant. The cost was put at £10,000; but the estimate was not quite so much. For the arrangement of the additional works they had to thank their Manager, who suggested a scheme less costly, more productive, and more profitable than the existing plant; and they might confidently expect a good return for the outlay. The prosperous state of the Company, traced back through 58 years, was worthy of some notice at the present time; and it was his pleasing duty to tell the shareholders that every shilling of full dividends had been paid from 1840 to the present time. Those who held the original stock of £37,440 had received back-dividends to make up the 10 per cent. from the origin of the Company. Then came the time for creating a reserve fund, which enabled the Company to overcome a loss of £4000, to replace a large gasholder that collapsed in a violent hurricane of wind storm, £2000 occasioned by the high price of coal during the strike of colliers, and another loss of £1000 per annum by the lowered price of the residual products; the full dividends having still been paid throughout. All this spoke well of the past; and there was every reason to look forward to a prosperous future. The new shares would be sold by auction.

Mr. PALMER asked if some shares had not lately been sold by the Directors themselves. He thought Mr. Peed had disposed of several.

The Chairman said the Directors had no knowledge whatever of it.

Mr. Palmer said it showed something very bad in the management if a body of gentlemen could be deceived by a man like Mr. Peed. There must have been great neglect in looking into the Company's affairs.

The Chairman: If you will allow me, I will read the only answer that can be given, and it is this: "The fraudulent defalcations of the late Secretary and Solicitor, Mr. W. Peed, is a painful subject to speak of; and all we can now say is that, with one exception, every case in which he acted so illegally the Directors have the opinion of high legal authority that the Company are not responsible for. A notice to this effect has been sent to all so fraudulently affected, with the one exception." That is all the information we can give you.

Mr. Palmer: Do not the Directors consider themselves responsible for the acts of their Secretary?

The Chairman? I have read the reply.

Mr. Palmer: I say the shareholders have nothing whatever to do with the defalcations of Willam Peed. He was your servant, and not the servant of the shareholders. We had no voice in electing him, in paying his salary, or anything of the kind. We did not even know what salary he had.

Mr. Fawcett seconded the motion.

Mr. Palmer: Will you tell us how these defalcations were found out—how they were detected?

The Chairman: By his bolting away. We knew nothing about it.

Mr. Palmer: Did he take the capital away with him?

The Chairman: That I cannot tell you. He stole it from us, certainly.

Mr. Palmer: Where was it? It ought to have been in the bank.

The Chairman: It ought to have been; but he had that particular capital to pay the mortgage off. He did not pay it off; he pocketed all but £500 out of £5000.

The Secretary said the item of £5000 they would observe in the general balance came about in this way: The mortgages originally bore interest at 4 per cent.; and the Directors gave notice to all the holders of their intention to reduce the rate to 3½ per cent. With one exception—Mr. Evans—they all accepted the new terms; but he declined, and notice was given to redeem. This involved raising the money from another source. The late Secretary was entrusted by the Directors with full power to procure the necessary funds. He raised the money, and the mortgages were duly sealed and issued to the holders. He received from the three mortgages in the early part of last year the total of £5000; but instead of paying off Evans's mortgage, he misappropriated or embezzled the money. The £5000 did not go through the accounts of the Company. It was not a new mortgage; it was simply shifting from one to another, and therefore the money did not go through the Company's banking account. Otherwise it would have been detected at the audit at the half year ended Midsummer last. It was not until Peed absconded that it was discovered that the money was not paid off Evans's mortgage.

Mr. Palmer said they should have had a London accountant. With all due respect to the Auditors, they were not competent to audit such gigantic matters as those of their Company, especially after the defalcations had occurred.

The Secretary stated that the question of auditing the accounts in the future was under the consideration of the Directors.

Mr. Matthews suggested that, in lieu of loans and mortgages, it would be better to issue preference stock.

The Chairman said they were doing exactly the same as other companies. If they were advised that a change should be made, the shareholders might rely upon it that the Directors would take the matter into consideration, and be pleased to comply.

Mr. French asked if Mr. Peed was under any bond.

The Chairman replied that he was not.

Mr. French: And yet he had the playing with all this money!

The Chairman pointed out that Mr. Peed, up to the time of his departure, had been for thirty years the Secretary and legal adviser of the Company. It happened singularly that he (the Chairman) was elected a Director the same year that Mr. Peed was appointed Secretary; and he could state, from personal experience, that no man could possibly have done more good service, until the recent transactions of his, for the Company, and done it with greater ability also, than did Mr. Peed. As this went on for many years, the Directors naturally placed in him implicit confidence; and no one could be more astonished than those who had worked with him, and had been thirty years with him, at the turn of events. He (the Chairman) was more astonished, perhaps, than other people would have been, because he placed implicit trust in him, and so did many others.

Mr. Matthews: Has any effort been made to bring him back?

The Chairman: I am not aware of any.

Mr. Matthews: I think there should be. I consider this is a second case of Jabez Balfour and Co.

The Chairman: We know no further than that a warrant has been taken out by another authority.

Mr. Matthews: That has nothing to do with the Gas or the Water Company. It is about time something was done, considering the number of things that have happened. The Public Prosecutor can be called in in the case of fraud for any paltry amount over £20, and yet we cannot have the Public Prosecutor here.

The Chairman: I have not studied the matter you are speaking of; and I cannot answer.

A Shareholder remarked that Mr. Peed seemed to have been master, and to have done just as he pleased. He thought it was not creditable to the Board not to try to get the man back.

Mr. Palmer said the Directors were partly responsible for the defalcations, as the late Secretary was their servant; and they ought to be called upon to pay the money back.

Mr. D. Wood asked if the bogus shares issued by Mr. Peed could not be entered upon a suspense account. He held in his hand several shares signed. He was quite sure that the signature of one gentleman was true; and he believed the other was also. They had the seal of the Company, and he had paid the money due for the transfer. How were they to know that these were false shares?

The Chairman said the whole of the circumstances of the case were placed before a high legal authority, and the Directors were acting under advice.

Mr. Matthews remarked that when Robson robbed the Crystal Palace Company, Redpath the Great Northern Railway Company, and Higgs the Great Central Gas Company, the Directors met the shareholders like men; but he was sorry to say this was not the case with the Cambridge Gas or the Water Company.

The Chairman said he regretted to hear that remark. Could they do otherwise? Their duty was to the shareholders. They were bound for the sake of the shareholders to take legal advice, and act upon it. If that was casting a reflection upon them as gentlemen, he did not understand the speaker.

Mr. Wood said the Directors should have seen that the papers were right before they signed them. He was acknowledged there as a shareholder. He held his position, and should request the dividend.

Mr. Palmer remarked that Mr. Wood had a very good case for a Court of Law.

Colonel Caldwell pointed out that the speakers were wandering from the question before the meeting, which was that of augmenting the capital of the Company.

The Chairman again read the motion, and it was carried.

A discussion then took place on the subject of the appointment of the new Secretary. Mr. King, at the request of the Chairman, read the sections of the Act giving the Directors power to elect a Secretary, but not to determine his remuneration; and the Chairman moved a resolution recommending an amount which they suggested as adequate for the combined duties of Solicitor and Secretary, with the addition of £10 per annum for stamps and stationery. This was agreed to with one dissentient—Mr. Palmer, who said the shareholders had nothing whatever to do with the election.

Mr. Gibson proposed a vote of thanks to the Chairman, to whom, he said, the meeting must have been a very painful one.

Mr. Wood asked what was to become of the Company's seal.

The Chairman said they had the seal now with two locks attached to it. There were different keys—one kept by himself, and one by the Secretary; so that one could not be used without the other. The seal would be used in the presence of the Chairman, in the office.

Mr. Wood: It should have been so before.

Mr. Hamblin Smith, in supporting the proposition, said he wished it had been considered right by the Directors to give the shareholders some more light upon the subject of the purchase of shares made by innocent purchasers. He hoped there might yet be an opportunity on some future occasion for every shareholder to consider what could be done to relieve these innocent people. He was sure none of the shareholders desired that persons who could be guilty of no offence should suffer.

Mr. Wood: The thing should be charged upon the whole Company. The matter is not settled by you; it must be settled by a Judge.

The motion was carried unanimously.

The Chairman, in acknowledging the vote, said the subject which had occupied the meeting was one of extreme regret to him. As to the money he had lost, this was but a snap of the finger, for he had never lamented anything which was gone. He was the most heavy sufferer privately through the defalcations; but he put this on one side. It was for others he felt most sincerely; and he could not help seeing that it had been to a certain extent caused by too implicit confidence being placed in one man, both by clients and also by companies. At the same time, he might say that Mr. Peed showed extraordinary ability as a lawyer, in doing good work for the Company; but he was equally strong in his ability to do secret work of a wrong character. They knew nothing until the outbreak came; but Mr. Peed did the thing so secretly, that he deceived them completely. He thanked them kindly for their feelings; and he hoped those who had lost money would take his warm-hearted sympathy, because he felt more for others than he did for himself over these defalcations.

The proceedings then terminated.

THE VIENNA GAS-WORKS LOAN.

The difficulty experienced by the Municipality of Vienna in raising the money for their gas-works has been much in evidence during the past fortnight. The "Neue Freie Presse" circulated a rumour that certain English banking-houses intended to render assistance; but, on a representative of the "Financial News" inquiring into the matter, the statement was emphatically denied. The denial has been reproduced in a number of Continental papers, including the one which first put the rumour in circulation. The "Hamburger Handelsblatt" remarks that it cannot be very encouraging for the Municipality to see their projects for a loan successively failing in Vienna, Berlin, Paris, and London. Writing on the subject last Friday, the Vienna Correspondent of the "Standard" said: "For the last fortnight the Vienna papers have been publishing daily telegrams from London regarding the progress of the negotiations between two of the town councillors, who had been sent by Dr. Lueger to England, and the London middlemen of certain financial groups, represented now as of Manchester and now as of London. The object was to place in England a municipal loan of 30,000,000 florins, or about £2,500,000, urgently required for the cost of the new gas-works. The idea of seeking the money in England was somewhat original, for, as will be remembered, the gas-works are being erected at a cost of 40,000,000 florins, and at immense inconvenience to the city—though the existing gas-works, with the plant, were to be had for 16,000,000 florins—simply because Dr. Lueger wanted to drive the English Company, the Imperial Continental Gas Association, out of Vienna. Ever since the London negotiations began, he has been unmercifully chaffed on the subject by the papers. He had, however, no choice, as the Vienna banks politely refused to lend any money to the present Municipal Administration, and as the negotiations with the Berlin banks had failed—the bankers demanding concessions for the Vienna electric tramways as an extra commission. Now it is reported that the London negotiations have also been broken off, and that the two town councillors are returning empty-handed. The reason is that they had no power to promise payment of interest and capital in pounds sterling; whereas the German creditors are usually content with the Austrian kronen. To Germany Dr. Lueger will have again to apply, and to pay the price demanded of him, as he cannot wait much longer. The credit of Vienna is perfectly sound; and, in other circumstances, the trifling sum could have been obtained within a few hours. But local capitalists have no great confidence in the experience and skill of the

present City Fathers; and foreigners are to be excused if they bear in mind the arbitrary treatment extended by Dr. Lueger to the English Gas Company and the Vienna Tramways Company, of which the present shareholders are mostly Germans." Last Saturday's "Financial News" contained an announcement sent from Zurich on the previous day, to the effect that a Syndicate had been formed of several Swiss banks and a Paris credit establishment, together with the Schneider firm at Creuzot, for placing the loan in connection with the electrical tramways.

THE PROFIT-SHARING SYSTEM AS A REMEDY FOR LABOUR TROUBLES.

At a dinner of the London Chamber of Commerce held last Tuesday at the Trocadero Restaurant, under the presidency of Mr. George Livesey, a discussion took place on the above subject.

The Chairman, in opening the debate, said the condition of the labouring classes had been one of continual progress from the slavery of ancient times; and it was not to be expected that they would remain satisfied with what they had already obtained as wage-earners. After careful consideration, he had come to the conclusion that they must look forward to the partnership of employer and employed; and it was in this sense he regarded profit-sharing favourably. When he started the system at the South Metropolitan Gas-Works, he had two objects in view—one was to attach the workmen to their employers, and the other to benefit the workmen themselves. The distribution of a cash bonus annually among the employees he considered as of very little use. What was wanted was some means whereby the workman became thrifty, and consequently, to some extent, a capitalist. Many employers naturally thought it would be a serious thing if their profits had to be reduced by (say) 5 per cent., consequent on the adoption of a scheme of profit-sharing. What they had to convince those employers of was that, if workmen would enter into the spirit of the thing, and do their best, they could easily save this 5 per cent., or whatever the percentage might be, by lessening the cost of production. Speaking generally, he believed the Trade Union leaders did not like the profit-sharing idea; and when Mr. A. Hills, of the Thames Iron-Works, tried to introduce it, the Engineers' Union would not have it. After explaining the system in operation at the South Metropolitan Gas-Works, the result of which had been so successful that the workmen had now standing to their credit upwards of £97,000, either in the stock of the Company or on deposit, he concluded by emphasizing the value of profit-sharing as tending to create better relations between employers and employees.

Mr. D. F. Schloss, of the Labour Department of the Board of Trade, said that, owing to his official position, he was unable to express any opinion as to the advantages or disadvantages of profit-sharing. He proceeded, however, to quote statistics showing the position of the movement, so far as ordinary business firms were concerned—excluding workmen's co-operative societies. The earliest case of profit-sharing in the British Empire of which there was a record occurred in 1829. Nothing was known of the adoption of other profit-sharing schemes until 1865, when the celebrated experiment of Messrs. Briggs was made in the coal trade. From that time onwards, experiments in profit-sharing had been made in numerous cases in a great variety of trades. In all, up to the middle of 1897, the number of cases in which profit-sharing was known to have been adopted was 170, in 73 of which it had since been abandoned. Of these 73 cases, the cause of its being given up was, in 25 instances, liquidation or want of financial success, and in 18 the dissatisfaction of the employers with the results obtained. In the 94 cases of existing profit-sharing schemes as to which particulars had been obtained, the total number of workpeople employed was 47,075—a large increase on the number in 1896 (29,069). With respect to the addition made by the bonus paid under profit-sharing schemes to the wages of the employees, the mean ratio of bonus to wages in all cases, including those in which no bonus had been earned, had been 4 per cent. in 1894, 4·7 per cent. in 1895, and 4·9 per cent. in 1896. Leaving out the cases of failure to earn bonus, the average ratio of bonus to wages, taking into account the number of participants in each case, had been 6·1 per cent. in 1894, 6·7 per cent. in 1895, and 10·3 per cent. in 1896. In 1896, the number of cases in which no bonus had been earned was 23, the number of workpeople employed under these schemes being 3654; while out of 12,042 employees who had shared in profits, 5337 had received a bonus equivalent to from 5 to 9 per cent. on their wages, and one firm with 2466 employees, of whom 2461 shared in profits, had paid a bonus at the rate of between 28 and 29 per cent. on wages.

Mr. T. C. Taylor (Messrs. J. T. & J. Taylor, Batley) said that profit-sharing employers were neither fanatics nor pharisees, but merely business men up to date. In his opinion, the greatest curse to the industry of Great Britain to-day was the frightful distrust which existed between employers and employed; and he believed that a fair profit-sharing scheme would do more to remove so regrettable a state of things than almost anything else.

Mr. H. Vivian gave an account of the methods adopted by the labour partnership movement, with which he is officially connected. At the present time, he said, they had more than 160 businesses of various kinds up and down the country conducted on the labour partnership principle, with a capital of more than £1,000,000; while the aggregate amount of trade done had grown from £160,000 in 1883 to upwards of £2,000,000 last year, and was steadily increasing. In all these businesses, the workers were admitted to a partnership in profits; and he believed that it was on some such lines as these that a solution of the difficulties constantly arising between workmen and employers would ultimately be found.

Other gentlemen took part in the discussion.

Filey Gas and Water Company.—At an extraordinary meeting of this Company last Tuesday, the Vice-Chairman (Mr. J. Pirie) announced that, acting upon the advice of their legal advisers, the Directors had decided to oppose the Gas Purchase Bill promoted by the District Council. The action of the Board was approved, with one dissentient. A resolution was also passed, authorizing the Directors to raise additional capital for the erection of a new gasholder capable of storing 100,000 cubic feet, and costing about £2000.

ELECTRIC LIGHTING NOTES.

Last Tuesday, the St. Heliers (Jersey) Parish Assembly adopted, practically unanimously, a petition to the States of the Island in favour of a Bill empowering the Municipality of the town to borrow a sum not exceeding £30,000 to provide an installation of electric light.

The Electrical Engineer of the Cardiff Corporation reports that the number of 8-candle power lamps fixed to the end of December was 15,431, as against 14,136 at the close of 1896. He also states that the results of the year's working show a surplus which will make it worth the Committee's while to reduce the rates for current.

The Redditch District Council have adopted plans for electric lighting works for the town. They are designed for supplying at one time 2200 16-candle lamps, with an additional 1100 connected to the mains. A canvass of the residents has been made, from which it is evident that 2000 lamps, or their equivalent, will be wired. Such a number, the Engineer says, would consume 60,000 units, representing, at 6d. a unit, £1500. The annual expense is estimated at £1290—leaving a profit of £210.

What is claimed to be the first instance of village electric lighting is to be found at Treeton, in South Yorkshire, where the Parish Council have, for a capital outlay of about £750, provided for the lighting of the whole village by means of arc lamps, one of which is stated to be of 3000-candle power. The electrical energy is obtained from the Rother Vale Colliery Company; and the annual expenses, including the sum required for the repayment of the loan, are expected to be less than if any other means of lighting had been adopted.

An extension of the electric plant of the Southport Corporation has just been completed; making the capacity of the works more than five times as great as it was when the installation was laid down rather more than three years ago. The third and latest addition to the plant consists of a dynamo, driven by a 500 horse-power engine. It has a capacity of 300 units, and is able to deal with 10,000 8-candle power lamps at one time; bringing the total up to 22,750 8-candle power lamps. The total expenditure on the installation has been about £60,000. A further extension has been resolved upon, which will cost £21,000 more.

The Chester Corporation electric lighting undertaking promises to be very successful from the all-important financial point of view. During the past year, the expenses amounted to £2400; while the receipts were £4985. The interest on the capital borrowed is £1269; this being calculated for the time the money has been used. The amount laid by for the sinking funds is £732, which leaves a net balance of about £565. The Electric Lighting Committee have dealt with this by giving their customers an extra discount according to consumption. This will absorb £421, and leave a balance of £141 to be carried to the next account. It is expected that the gross income this year will be quite £8000.

A very serious matter, from the ratepayers' point of view, was considered by the St. Pancras Vestry on Wednesday. Certain extensions to the Regent's Park station are deemed necessary by the Electric Lighting Department, and the estimated cost thereof is no less than £26,439. The scheme provides for the erection of a new chimney-shaft and buildings, including an additional boiler-house, and heightening the engine-room so as to accommodate four 750-horse power engines. There are also included various offices, a battery-room, condensing plant, air-pumps, boilers, elevators, and "other minor accessories." The £26,439 will not be required immediately, for the report shows that the capital expenditure on the portion of the building and plant completed by the end of the present year will be about £21,440. This sum includes the cost of the chimney and offices, and represents the amount then payable to the Contractors, inclusive of £9440 which will be due for the engines already ordered. The estimated capital outlay, when the buildings are completed, with four 500-horse power boilers and the three existing Babcock boilers, with all accessories, will be £39,019. This amount, less £12,580 already sanctioned for the engines, makes the further required sum of £26,439. The motion of Mr. H. J. Menzies, the Chairman of the Electric Lighting Committee, was to the effect that the plans should be approved, and copies forwarded to the London County Council for their sanction; and that tenders should be invited for carrying out the work. After a long explanatory speech by Mr. Menzies, Mr. Close seconded. Dr. Walter Smith strongly opposed the scheme, on the ground of the Committee's financial condition; and he was well supported by Mr. M'Gregor. In the end, however, the motion was passed with but little real criticism.

The Gas Prepayment System at Huddersfield.—From April next the Huddersfield Corporation Gas Committee intend supplying penny-in-the-slot gas cooking stoves at a charge of 1d. per 30 cubic feet of gas. There are now 1034 prepayment meters in use.

The Irregularities at the Bury Gas-Works.—A special meeting of the Bury Town Council was held last Thursday to receive a report from the Gas Committee "in reference to certain irregularities" at the Bury Gas-Works (see *ante*, p. 142). The Chairman of the Committee (Mr. J. Byrom) stated that, arising out of their inquiries, the Gas Committee had been authorized by the General Purposes Committee to commence legal proceedings against certain persons who had been serving them with coal. The Committee deplored the fact that it had been found necessary to discharge the Gas Manager. The irregularity in the delivery of coal had gone on for a number of years. The proceedings of the Committee were confirmed.

Fatal Accident at the Schoneberg (Berlin) Gas-Works.—An explosion occurred on the 13th inst. in the governor-house at the Schöneberg works of the Imperial Continental Gas Association in Berlin, by which four workmen were killed and two so seriously injured that they are not expected to recover. The accident took place while the men were repairing one of the governors after the foreman had carefully extinguished every light in the building, and as an extra measure of precaution had even put out the pilot light of the public lamp opposite the gate of the works. As all the men actually engaged on the job were killed, it will probably be impossible to determine the cause of the explosion, which practically wrecked the governor-house, but fortunately, did not cause any interruption in the supply of gas. The victims were buried on Monday last week; nearly 3000 people, among whom were many employees from other gas-works in Berlin, being present.

THE METROPOLITAN WATER SUPPLY COMMISSION.

Fourth Day—Monday, Jan. 17.

(*Viscount* LLANDAFF, *Chairman*, *Sir* JOHN E. DORINGTON, Bart., M.P., *Sir* G. B. BRUCE, M.Inst.C.E., *Major-General* A. DE COURCY SCOTT, R.E., *the Right Hon.* J. W. MELLOR, Q.C., M.P., *Mr.* A. DE BOCK PORTER, C.B., *Mr.* H. W. CRIPPS, Q.C., and *Mr.* R. LEWIS.)

This was the first sitting of the Commission after the Christmas recess; the proceedings taking place, as on previous occasions,* in the Moses Room of the House of Lords.

The following are the Counsel engaged: Mr. POPE, Q.C., and Mr. CLAUDE BAGGALLAY, Q.C., for the New River Company; Mr. LITTLER, Q.C., and Mr. LEWIS COWARD for the Kent Water Company; Mr. PEMBER, Q.C., for the Lambeth, East London, Grand Junction, and West Middlesex Water Companies; Mr. RICKARDS for the Chelsea Water Company; Lord R. CECIL for the Hertfordshire County Council; Mr. BALFOUR BROWNE, Q.C., and Mr. FREEMAN, Q.C., for the London County Council; Sir R. NICHOLSON for the Middlesex County Council; and Mr. GABRIEL P. GOLDNEY (Remembrancer) for the Corporation of the City of London. The Southwark and Vauxhall Water Company are represented by Messrs. BIRCHAM AND CO.

On the resumption of the inquiry, further evidence was given on behalf of the London County Council.

Sir *Alexander Binnie*, the Chief Engineer to the Council, in reply to the CHAIRMAN, said the area of the Administrative County of London was 121 square miles; and the population had risen from 2,808,862 in 1861, to 4,433,118 in 1896. In the "Outer Ring"—the Metropolitan Police district—the population had increased from 413,858 in 1861, to 1,401,688 in 1891. Taking the two together, this showed that Greater London had increased between 1861 and 1871, at the rate of 20·6 per cent.; between 1871 and 1881, at the rate of 22·7 per cent.; and between 1881 and 1891, at the rate of 18·2 per cent. In the Administrative County in the same decennial periods, the increases were respectively: 16·3, 17·4, and 10·4 per cent.; and in the Outer Ring in the same periods the increases were respectively: 49·5, 50·7, and 50·3 per cent. In thirty years the increase in the Administrative County had been about 50 per cent.; in the Outer Ring the increase had been 238·7 per cent.; and in Greater London as a whole 74·8 per cent. Water London contained an area of 620 square miles, of which 476 were within, and 144 outside, the area of Greater London. The Southwark and Vauxhall Company had a total parliamentary area of 50½ square miles, of which 39½ were within, and 11 outside, the County of London. The district was overlapped by that of the West Middlesex Company to the extent of 17½ square miles, by that of the Lambeth Company to the extent of 41 square miles, by that of the Kent Company to the extent of 7½ square miles, and by that of the Richmond Corporation to the extent of 2 square miles. Within the area of the Southwark and Vauxhall Company, both the Lambeth and the Kent Companies supplied water. Regarding the places where competition was actually occurring, he said the principal case was that of the Southwark and Vauxhall and the Lambeth Companies. The localities were: St. Mary's, Lambeth, 640 acres; Christ Church, 25 acres; St. George the Martyr, 160 acres; St. Saviour's, Southwark, a street or two; Bermondsey, 14 acres; St. Giles, Camberwell, 110 acres; and Newington, 400 acres—a total of 1349 acres. In all these places there were separate sets of mains laid by the two Companies in each street; and it was quite open for consumers to take which supply they chose. The Southwark and Vauxhall Company, he believed, supplied in a region outside their parliamentary territory and in the Lambeth Company's district. He presumed this was by mutual agreement; he could not explain it otherwise. The Lambeth Company had a total parliamentary area of 104 square miles, of which 42 were within, and 62 outside, the County of London. The Company's district was overlapped by the West Middlesex Company, the Kent Company, the Croydon Corporation, and the Sutton Company; and in this case, as in most of the others, one or more of the overlapping Companies supplied water in parts of the district overlapped. Regarding a portion of the area supplied by the Lambeth Company, he believed the Company had no statutory powers; it might be that they supplied there before the boundary was fixed. The Kent Company had power to supply 212 square miles, 38 of which were within, and 174 outside, the County of London; and the overlapping Companies were the Southwark and Vauxhall, the Lambeth, the East London, and the Limpsfield and Oxted. The East London Company's area of supply was 139 square miles; 21 being within, and 118 outside, the County of London. The Companies overlapping were the Kent, the New River, and the South Essex; and the Tottenham Urban District Council also had power to supply a small portion. The South Essex Company came within Water London to the extent of about 48 miles.

The CHAIRMAN remarked that this being so, there would be a ninth Company to be dealt with.

Witness (continuing) said there might be cases in the neighbourhood of Barnet and the Colne Valley of other small companies overlapping the East London Company's area. The parliamentary area of the New River Company was 107 square miles—25 being within, and 82 outside, the County of London. The East London, the West Middlesex, the Chelsea, and the Grand Junction Companies all overlapped it; and five local authorities had power to supply their respective districts. The West Middlesex Company's area totalled 85 square miles; 34 being within, and 51 outside, the County of London. In this case also, there was considerable overlapping by the New River, the Chelsea, the Grand Junction, the Southwark and Vauxhall, the Lambeth, and the Colne Valley Companies. The Richmond Corporation also had power to supply a part of the locality. In one place, just to the north of Campden Hill, about 65 acres in extent, the Grand Junction and the West Middlesex Companies had mains in the same street; but whether they both supplied the houses, or how they had apportioned the supplies, he could not say. The Grand Junction Company had power over 52½ square miles; 13½ being within, and 39 outside, the County of London. In this case, there was overlapping to a considerable degree by the Chelsea and West Middlesex Companies; and to a small extent by the New River and the South West Suburban Companies. The Grand Junction Company were supplying a district at Sunbury adjoining, but outside their statutory area. How this came about, he was unable to explain. The Chelsea Company's area was 20½ square miles; all being within the County of London. The overlapping Companies were the New River, the West Middlesex, and the Grand Junction. Taking the Companies together, they had power of supply over 770½ square miles, or 150½ square miles more than the total area of Water London; and taking the County of London at 121 square miles, they were, owing to overlapping, entitled to supply 233⅓ miles, or nearly double that area. Proceeding, he pointed out that in 1896 the population supplied was 5,606,920 persons; the average daily supply being 197,988,052 gallons, or 35·31 gallons per head. He then went through some calculations, as a result of which he brought out that the Administrative County of London was interested in the total water supply of the eight Companies to the extent of about 79¼ per cent.; and the districts outside, taken together, to the extent of 20¾ per cent. Continuing, he said the sources of supply were chiefly the flow of the Thames and the Lea, springs and wells sunk in the chalk of the Lea Valley, and the Kent wells. Witness went on to give particulars regarding the points of intake, &c. On the Thames, there was no intake below Hampton, save in the case of two Companies, who, in emergency, could—with the consent of the Local Government Board—pump from their old stations at Seething Wells.

Mr. RICKARDS read from the Act, showing that, in the case of the Chelsea Company, though they had to report the taking of water through this intake to the Local Government Board, yet the Board had no veto, and apparently no control.

Witness (continuing) produced tables showing the average daily quantity of water obtained from the Thames, the Lea, and the various other sources—the figure for the eight Companies being 189,332,467 gallons in 1894, 211,986,498 gallons in 1895, and 197,988,052 gallons in 1896. The quantity authorized to be taken daily from the Thames was, prior to 1893, 22 million gallons by the Chelsea Company; 10 millions by the East London; and 24½ millions each in the case of the West Middlesex, Grand Junction, Lambeth, and Southwark and Vauxhall Companies—a total of 130 million gallons a day. Under the Staines Reservoirs Act, an average of 35 million gallons daily, and under the Southwark and Vauxhall Act of 1897 a further 20½ million gallons daily, had been authorized; making a total of 185½ million gallons. As to checks upon the quantity of water taken, the Companies made returns, and he believed they had meters to measure what they took; but he was not sure that the meters were open to inspection.

Mr. PEMBER quoted the Thames Conservancy Act of 1894, under which the Companies were bound to provide suitable appliances, to be approved by the Conservators, for measuring the water taken, which were to be open to inspection; and arbitration was provided for in case of dispute.

Witness, as showing the inefficiency of the control exercised over the Companies, referred to the action brought last year by the Conservators against the Southwark and Vauxhall Company, in which the Court decided that the Company had power to take much less water than they actually were taking. Yet immediately afterwards the Conservators and the Company negotiated a Bill, by which, for a money payment per million gallons, the Company were to be allowed to take a certain quantity of water. He knew of no power under which the Conservators could sell the water of the Thames. The County Council only had one representative on the Conservancy Board; and he voted consistently against this arrangement.

Mr. BAGGALLAY said the bulk of the Companies taking water from the Thames were only restricted by agreements entered into voluntarily with the Corporation or with the Conservancy Board.

Mr. PEMBER remarked that the East London Company had power to take as much water as they could get, when the river was in flood.

Witness said this was in direct opposition to the finding of Lord Balfour's Commission. Continuing, he stated that the take from the Thames had been, as a whole, much below what was authorized, though in some months it was very near the maximum. Regarding the quantity authorized to be taken from the Lea, he said that was very difficult to work out. He referred, however, to a table of the New River Company, where they claimed power to take 22½ million gallons a day; and before Lord Balfour's Commission, the East London Company claimed 30 million gallons a day. He had no means of really discovering what quantity was authorized.

Mr. PEMBER read section 9 of the River Lea Water Act of 1855, under which all the water that the Trustees under the Act of 1850 had power to sell, with certain reservations for navigation purposes, &c., was sold to the New River and the East London Companies, in varying proportions. Subject to the reservation of certain quantities, practically the whole of the River Lea belonged to these two Companies.

Mr. FREEMAN said this was absolutely disputed. First, it was contended that the Trustees could not sell more than a certain quantity of water; and then it was very doubtful what the powers of the Trustees were under the Act of 1850.

Witness (continuing) said the quantity taken from the Lea nearly always exceeded the 52½ million gallons. As a fact, the two Companies absorbed in the dry months the whole flow of the river; and the quantity sent down from the upper reaches was insufficient for navigation. Indeed, the East London Company had erected pumping machinery by which the tidal water at Bow Creek was pumped into the lower reaches of the Lea, to supply the deficiency.

Mr. BAGGALLAY and Mr. PEMBER remarked that they could not admit these statements.

Witness said the County Council were anxious to preserve the cleanliness of the lower part of the Lea; and this could only be done by allowing the upland water to flow down.

Mr. PEMBER read a section of an Act under which the East London Company were allowed to pump from ponds into the Lea.

The CHAIRMAN pointed out that the section said nothing about pumping from the lower reaches into the upper ones. Really they were taking water from the Thames; and the East London Company had no powers to do this.

Witness said that, having regard to the evidence given by the Water Companies, and to the investigations of the County Council, and seeing that the water supply of London must be more than doubled in the next thirty or forty years, he thought it expedient that they should go to

* See "JOURNAL," Vol. LXX., pp. 1186, 1298, 1352.

some fresh sources, not in substitution for, but to supplement, the existing ones. The present supply was as satisfactory as it could be—drawn from its present sources. It was, however, liable to epidemic. If they had a source which received the clarified sewage, directly or indirectly, of a million of people, although the water might not poison people it was always liable to be the cause of disease. He would go on using the present supply, but would not take more from the same sources.

Mr. PEMBER: Apparently he would poison the present population, but not the future.

Witness: Say rather I would reduce the risks of poisoning anybody.

Fifth Day—Tuesday, Jan. 18.

Sir *A. Binnie*, recalled and further examined by the CHAIRMAN, emphasized the fact that any new source of water supply must be supplemental to, and not in substitution for, the present ones. The 185½ million gallons which it was suggested by Lord Balfour's Commission could be obtained from the existing sources, should continue to be taken, and should be paid for under any scheme of purchase; but he anticipated that this would require to be supplemented ten or fifteen years hence.

The CHAIRMAN: In that case, the works necessary for the supplemental supply would have to be commenced almost immediately?

Witness: The sooner they are commenced, the better.

In what direction would you look for your supplemental sources of supply?—Some district in Wales. Witness went on to say that, upon the question of the provision which should be made for the storage and purification of the water derived from the existing sources, he considered that entire reliance should not be placed on the effect of filtration as a barrier against infection caused by the consumption of river water derived from streams which received the more or less clarified sewage of over a million persons. In this connection, he specially directed the attention of the Commission to the following remarks contained in Lord Balfour's report:

We have further to consider what steps should be taken to insure the proper treatment of the water that is taken from the Thames and the Lea for the supply of London; for the water that flows down to the intakes must be subjected to certain important processes before it is brought into a suitable condition for delivery and consumption. These processes consist of subsidence and filtration; and the quality of the water, when delivered, depends largely upon the thoroughness with which they are carried out. It does not come within the terms of our reference to lay down what should be the exact regulations as regards filtration—that is to say, what should be the proportionate area of the filtering beds, the depth of sand, the frequency of renewal, or the rate at which the water should be allowed to percolate; nor, as regards the subsidence tanks, how many days' storage should be deemed sufficient so as to obviate the necessity of taking in turbid storm water, and to allow of due settlement. But we cannot shut our eyes to the fact that the provision for these purposes differs enormously in the different companies, and in some of them is, to our mind, quite inadequate. Regulations on these matters should be drawn up after competent inquiry; and adherence to these regulations should be strictly enforced. This enforcement should be entrusted to the public Water Examiner, who should have the legal right of entry into all the water-works, and the duty of reporting periodically as to the due observance of the conditions laid down. At present, the Examiner is only admitted to the works on sufferance; and though he has distinctly informed us that he has always been admitted, not only without hesitation but with all courtesy by the various Companies, it is plain that the standing ground of a man who is inspecting by right is very different from that of one who is only present by courtesy.

General SCOTT: You wish to show us, as I understand, that certain regulations are required for the purpose of carrying out what Lord Balfour's Commission recommended for the exclusion of flood water.

Witness: Yes; and, in the second place, for how long a period the Companies would have to cease, not only from drawing from the Thames, but to supplement the water of the Thames.

I take it that Lord Balfour's Commission meant that there should be left in the river a certain amount of water which is now taken away from it?—Yes. Continuing, witness said that the calculations which he had in his possession all went to show how, under existing circumstances, the total flow of the Thames was gradually being absorbed by the Water Companies, and how important it was that the following recommendation of Lord Balfour's Commission should be carried out: "We think that regulations should be framed under which the quantity we suggest could be taken, not only without reducing the flow of the river on the rare occasions of exceptional drought to the present mimimum, but in such a way as to secure that the volume of water left in the river at these times should be substantially greater than it is under existing conditions." This clearly pointed, not only to the Water Companies refraining from drawing water from the Thames during dry seasons, but to their adding to the natural flow, out of the storage reservoirs constructed by them, a quantity of water which would materially improve the circumstances at present existing. Mr. More, the Engineer to the Thames Conservancy, in his evidence before Sir Joseph Pease's Committee in 1896, stated that if there was a flow of less than 200 million gallons per day, the river below Richmond would be rendered almost unnavigable at low water. Mr. More proposed to meet the abstraction of water by the Water Companies by the construction of a reservoir in Richmond deer park, capable of storing 50 million gallons of water of each rising tide—that is to say, 100 million gallons a day. Looking at the question from the County Council's point of view, there was a much more important matter hanging upon this. The Council had charge of the main drainage of the Metropolis. They and their predecessors had spent 6½ millions of money in draining London and removing the sewage outfalls to Barking and Crossness; and in recent years the Council had spent nearly a million on works for treating the sewage at these stations, and had incurred an annual charge of £150,000 for the work. The beneficial effect produced on the river by this treatment was acknowledged by everyone acquainted with the facts; but it would be rapidly rendered nugatory if the present abstraction of upland water was allowed to continue. In fact, a further abstraction of water from the Thames was fraught with danger of the gravest kind to the whole of the inhabitants of London. Therefore he suggested that under no circumstances must the flow over Teddington Weir be reduced to less than 250 million gallons a day.

The CHAIRMAN: To what extent would this cut down the supply which the Water Companies should be authorized to take?

Witness: It need not do so at all, if they increase their reservoirs to a sufficient capacity.

They would still be able to take their 185½ million gallons?—By properly designing their works, they would be able to do so.

Are not the reservoirs authorized by the Staines Reservoirs' Act sufficient?—I think not. Even now the Companies are asking to increase their original storage capacity by one-third.

What extent of storage capacity would be necessary to secure a flow of 250 million gallons a day over Teddington Weir, and at the same time enable the Companies to maintain their supply?—Certainly three or four months' storage would be necessary. He could hardly say positively what storage capacity would be required, supposing the whole 300 million gallons which Lord Balfour's Commission estimated would be required to meet the needs of the population in 1931, were taken from the Thames. But he would go so far as to say that it would be necessary to have a reservoir capacity equal to 90 days' storage of 300 million gallons per day. In other words, the Companies would require a reservoir capacity of 27,000 million gallons, instead of the 17,500 million gallons which they stated before Lord Balfour's Commission they intended to provide.

Sir GEORGE BRUCE: That is to say, you would supply London out of the reservoirs for 90 days, as if there were no Thames in existence.

Witness: Exactly so.

The CHAIRMAN: What further regulations would you suggest for carrying out these recommendations of Lord Balfour's Commission?

Witness: I would also recommend that no water should be drawn from the Thames when it is in a turbid condition. I admit that turbid water is somewhat difficult to define; but what I mean is that water should not be taken from the Thames when it is in flood or very low. For instance, when the water contains much suspended matter, or when there are dangerous microbes present, it should not be used for so many hours.

These regulations—(1) That there should be a minimum daily flow of 250 million gallons over Teddington Weir; (2) That there should be 90 days' storage of the average supply; and (3) that no water should be drawn from the Thames when it is in a turbid condition—would probably have to be framed by some body quite independent of the authority who supplied the water?—They should be statutory regulations after inquiry. General rules might be laid down for the guidance of those in charge of the water.

In whom would you vest the authority to say whether or not these regulations had been complied with?—I should make them a parliamentary obligation, subject to a penalty if they were not carried out.

Turning to the question of the sources of supply, can you give us any idea what the cost of going to Wales would be?—It would vary from £90,000 to £96,000 per million gallons delivered per day. Of the five Welsh sources, the Usk and Llangorse areas would yield 182 million gallons per day; the Yrfon and Torvy, 135 millions; the Edw, 18 millions; the Ithon, 37 millions; and the Upper Wye, 43 millions—415 million gallons in all. At first, a preference was given to the Llangorse scheme; but after further consideration, we came to the conclusion that the Yrfon offered greater advantages, and it is the one which would probably be selected. With regard to the immediate future, everyone is agreed that the powers recently granted by Parliament would give a supply sufficient for the next ten or fifteen years. Going beyond that date, in the year 1931 the existing sources of supply—the Thames and the Lea—would have to be supplemented by 147 million gallons a day; and if that water was brought from Wales, it would cost £14,112,800. In order to provide for the necessities of 1948, there would have to be a further expenditure of £12,000,000—making a total of £26,000,000. I do not look further ahead than fifty years from the present time.

What do you say with regard to the height of supply?—It would be a great advantage if the Water Companies were compelled to supply water at high pressure up to the tops of the highest houses.

What regulations would you suggest with a view of preventing failure of supply?—The Companies should be compelled by statute to lay their pipes at a depth of not less than 2 ft. 6in. below the surface—the depth which they lay down in their own regulations for private consumers. In cases where a supply is not afforded by a company or corporation, the consumer should be allowed to recover his water-rates. On the other hand, there should be regulations to prevent waste in the consumers' pipes; but I would not entrust companies with the same power of control over the consumers' pipes as is given to corporations and other local authorities. Further, the water supply of London should be placed in the hands of a publicly elected body, by direct appeal to whom these matters could be settled at once.

Witness, in reply to further questions by the CHAIRMAN, said he did not regard a partition of the districts as a necessary accompaniment of purchase by the London County Council. It could not be forced upon the Companies, but must be carried out by agreement.

The examination of the witness was not concluded when the Commission adjourned to yesterday (Monday).

On meeting yesterday, Mr. Balfour Browne said the London County Council had never had any desire to make a case before the Commission; and all the evidence they had tendered had been, as the Council understood it, in answer to a written requisition of the Commission. If the Chairman thought they had gone beyond this, the Council were very sorry; and if he would limit or narrow the lines, the Council would endeavour to confine themselves to them. On a previous occasion the Chairman had asked for the results of provincial purchase. This was a very important matter; and he (Mr. Balfour Browne) wished to know whether it would be satisfactory if this evidence were given through an officer of the London County Council or whether he would require it to be given directly by the Town Clerks of the particular towns. Mr. Pember remarked that he should raise no objection to the evidence being given by an officer of the Council in the first instance, provided an opportunity of testing the evidence were given. The Chairman was understood to say that the evidence would be accepted from an officer of the Council. Mr. Balfour Browne added that the Council had not endeavoured to go behind the report of Lord Balfour's Committee. They had endeavoured to take the facts in that report as being accurate, but had also endeavoured to point out certain things which had happened since. The Chairman responded that, as might have been noticed, he had allowed Sir Alexander Binnie to go beyond the report in certain matters. Sir Alexander Binnie was then further examined by the Chairman.

HARROGATE WATER-WORKS PURCHASE ARBITRATION.

Westminster Palace Hotel.—Tuesday, Jan. 18.

(*Before* Mr. SHIRESS WILL, Q.C., *Umpire.*)

This was an arbitration held to determine the amount to be paid by the Corporation of Harrogate to the Harrogate Water Company for the acquisition of their undertaking.

Mr. J. MANSERGH, M.Inst.C.E., was Arbitrator for the Corporation; Mr. T. FENWICK, M.Inst.C.E., acted in a similar capacity for the Company. Mr. BALFOUR BROWNE, Q.C., and Mr. W. MACKENZIE appeared for the Corporation; Mr. TINDAL ATKINSON, Q.C., and Mr. HONORATIUS LLOYD represented the Company.

Mr. ATKINSON, in opening, said last session the Company promoted a Bill for the purpose of raising £90,000 of fresh capital with which to extend their works and make a new reservoir. The Corporation at the same time promoted a Bill authorizing them to purchase the undertaking. Both became law; and it was under the Corporation Bill that the present proceedings were being taken. The Company was formed in 1846, under an Act which gave them power to acquire certain springs at Harlow Hill, and to construct reservoirs adjacent, known as the Irongate reservoirs. The capital was fixed at £8000, with borrowing powers of £2500, and a maximum dividend of 10 per cent. When the railway came to Harrogate in 1862, the population began rapidly to increase. In that time, the Company had raised voluntarily from their shareholders £8800, and expended out of profits a further £2400. To meet the growth of population, and to enlarge the works so as to secure a greater supply, the Company obtained a further Act in 1869 empowering them to increase their capital by £28,000—£16,800 being new capital, and the balance of £11,200 being in liquidation of the £8800 and £2400. The £11,200 was made 5 per cent. preference stock. The maximum dividend on the £16,800 was put at 7 per cent. The works authorized under the Act were a new reservoir in Haverah Park, with a capacity of 36 million gallons, and a new service reservoir at Harlow Hill. These two works formed the present high service of the Company. Power was also taken to raise £2300 of perpetual debenture stock, which, with the £2500 formerly authorized, made the £4800 which was the present debenture stock of the Company; and also to raise £4200 of mortgage bonds. The population of the town increased rapidly; and in 1880 the Company secured a Provisional Order under the Gas and Water Facilities Act, by which they increased their capital by £40,000, with borrowing powers of £10,000—the maximum dividend being 7 per cent. The share capital now stood at £76,000, and the loan capital at £19,000—a total of £95,000. The supply was ample for the area; and there had never been any trouble with reference to it. There had just been a land "boom" in Harrogate. Many buildings had been erected, among them large new baths, on which the Corporation had spent nearly a quarter of a million of money; and it was in view of this development that the Company went to Parliament last year for further capital to make a new reservoir on the line of the Scargill Beck. The gathering area of this reservoir was practically all moorland; and the water therefore had little chance of contamination. It was not only pure, but beautifully soft. The Company did not start paying dividends till 1857, when they commenced with the 10 per cent. stock. In 1894, they began paying full dividends on all classes of stock, and had continued doing so ever since. For several years past there had been a surplus out of which they had paid up all the back dividends; and they now had in hand about £2700, which could only be dealt with by reducing the charges or creating a reserve fund. The net profit of the Company was steadily on the increase; it having been £4454 in 1886, and £8790 in 1897. Having regard to the very sound position of the undertaking, the Company's valuers based their calculations on the 2¾ per cent. table, which gave 36·36 as the number of years' purchase of the amount of dividends they could distribute. The ordinary stock was taken as being of the same value as the preference stock—a course which they justified by referring to the surplus which the Company now made. The £4800 of 4½ per cent. debenture stock was capitalized on the 2½ per cent. basis, which gave 40 years' purchase. Then the Company held that they were entitled to have included the amount of stock which they could create, under the Companies Clauses Act of 1845, by converting their mortgages into new stock. The time had now arrived—the Company having cleared off their arrears of dividend—when they would naturally adopt the course of converting this stock; and, looking to the sound position of the undertaking, they would have no difficulty in doing so.

Mr. *E. K. Burstal*, M.Inst.C.E., examined by Mr. LLOYD, gave in detail particulars of the works, mains, &c., of the Company. The total storage capacity was 179 million gallons; but owing to a slight defect in one reservoir, he reckoned it at only 151 million gallons. In addition to the ordinary supply, there was a well which yielded an average of 64,000 gallons daily. All the mains (of which there were 47 miles) and works were in good condition, and had been excellently maintained. The outlay on renewals had been £500 in 1894, £200 in 1895, £412 in 1896, and £603 in 1897, besides the amount spent on maintenance. The capital expenditure worked out to £3 10s. per head supplied, which was very low. The growth of the Company had been extremely rapid; the profit being £4454 in 1886, and £8790 in 1897. The amount required to pay one year's dividend was £6049; so there was a substantial margin. There was some doubt how the Company could legally charge; but if they had power to levy on the rack rental of premises, then they were at present charging 25 per cent. below what they had the right to. As to the rainfall, witness took Professor Symons' figure of 31 inches—the average over a long series of years. The evaporation he put at 15 inches; and the net available rainfall, at 9·8 inches. The drainage area was 1073 acres. These figures gave a daily yield of 651,950 gallons, which, with 64,000 gallons daily from springs, made 715,900 gallons. This, on the basis of 25 gallons per head, was sufficient for 28,500 persons. The present population supplied was 26,600. In 1889, the meter consumption was 4·4 gallons per head daily; the domestic consumption, 21·3 gallons—a total of 25·7 gallons. Now the meter consumption had risen to 6·8 gallons; and the domestic consumption, to 28 gallons. Not being satisfied with this increase, he had had tests made, with the result that a waste of 8 gallons per head daily was discovered. On the question of storage, he said it was recognized by the authorities of the district that 200 days was sufficient; but the storage of the Company was enough, not only for this period, but for 31 days besides. In his valuation, he first took the ordinary and preference shares, the interest on which aggregated £5336; and to this he applied the multiplier of 36·36, bringing out £194,016. He thought he was justified in taking 36·36 years, owing to the enormous appreciation in public securities that had taken place recently. The £216 interest on £4800 of 4½ per cent. debenture stock, he capitalized at 40 years' purchase, which gave £8640. The next item was the mortgage bonds, the interest on which was 3½ per cent., and which the Company were entitled to convert at 7 per cent. The balance of the interest worked out to £497, which he capitalized on the 36·36 years' basis—giving £18,071. These three amounts—£194,016, £8640, and £18,071—totalled £220,727, to which he added 10 per cent. for compulsory purchase, making a final figure of £242,800. This he held to be a fair price to be paid for the concern, seeing that the Company had a greater margin than he had ever before known a Company to have.

Cross-examined by Mr. BALFOUR BROWNE: The figures he had given of the storage capacity included the very last drop of water in the reservoirs, and allowed nothing for "bottom water," for which, however, a deduction would have to be made. The mains were in good repair; but none had been taken up specially in order that he might inspect them. Of late years, the expenditure on renewals had been very heavy—exceptionally so in 1897, a good deal of the cost in that year being due to the enlargement of the mains. The average cost of renewals in the last four years was much more than formerly; but the increase in the population rendered it necessary to enlarge the mains. The percentage of profit recently, too, had gone down; but only slightly. The Company had no reserve fund. As they only completed the payment of the back dividends last year, they had not yet had time to make one. As to the year 1893, when it was suggested there was a shortness of water, witness said it was matter of notoriety that there was a general shortness throughout the country. He believed that Leeds was very short then; Leicester he knew was. The quality of the water was excellent; but the Company had adopted the common plan of erecting filters. There was no doubt whatever that the time had now arrived when the Company ought to increase their filter accommodation. With regard to the rainfall, which he took at 31 inches, he admitted that in the parliamentary proceedings last year he stated the quantity at 27·65 inches, being the average of a number of years. In taking the gauges on which this figure was based as correct, however, he made some error; and Professor Symons having visited the district specially, and reported that the rain-gauges were not in a proper position, witness turned from his former figures and accepted those of the Professor. Last year the consumption actually in Harrogate was 34·8 gallons a head daily; and if his calculation as to the sufficiency of the supply were based on this figure, instead of on 25 gallons, the population that could be supplied would be reduced by one-third. In his calculation, he assumed that the visitors for whom allowance was made, were spread over the whole of the year. He did not think this was an improper thing to do, having regard to the large storage of the Company; nor that they should be reckoned as being all in the town in the course of the short period forming the season. There was such a large margin of profit beyond what was required to pay the dividend on the ordinary stock, that he saw no difference between its value and that of the preference stock. He did not agree that the margin would be absorbed by the new works which the Company would have to erect if they were to continue in existence. The Company could raise the capital at a little over 3 per cent. Questioned as to why he had calculated that they would be able to raise it at less than 3 per cent., he said 3 per cent. was the recognized basis in the case of a moderately secured undertaking. This being a concern having its income secured over and over again, he had taken a more favourable figure. He agreed that an epidemic of typhoid would be very serious for Harrogate, and consequently for the Company; but they might as well talk about cholera in London.

Some conversation passed between Counsel regarding the position of the debenture holders; doubt being expressed whether the Corporation could take over these securities, which were irredeemable.

The UMPIRE said, in the absence of agreement on both sides, it would be for him and the Arbitrators to construe the Act of Parliament.

Mr. BALFOUR BROWNE remarked that he was told the Corporation would be willing to take them over as a first charge on the undertaking.

After further discussion, the matter was left over; it being understood that reference would be made to it subsequently.

The cross-examination of the witness was not concluded when the proceedings were adjourned.

Wednesday, Jan. 19.

On the resumption of the proceedings this morning,

Mr. MOON, a Counsel not formally engaged in the case, brought under the notice of the Court the position of a Mr. Hornby, who was a holder of both debenture and preference stock in the Company. It was not certain that, as a debenture holder, he was to be paid off or taken over by the Corporation; nor, in the event of his being paid off, what sum he was to receive for his stock.

Mr. LLOYD said it did not matter to the Company whether the Corporation took over the debenture stock or not; but it must be clearly stated in the award what was included in it. There might be some doubt as to whether the Corporation could take over the debenture debt; and the Company must therefore be protected.

The UMPIRE said his impression was that the word "mortgages" in the Act included debenture stock (in which case the debenture stock would be taken over as a first charge on the undertaking); and this should be made clear in the award.

Mr. MOON thought this would be satisfactory to his client. There was one other point which he wished to state—namely, that his client, as a preference shareholder, would claim preference in the distribution of the amount of the award among all classes of shareholders.

Mr. BALFOUR BROWNE said that was a matter which they could not go into with Mr. Moon.

Mr. *Burstal*, in further cross-examination, said it would be an advantage, but not a necessity, to line the service reservoirs with concrete, so as to prevent the lodgment of dirt. It was proper to leave the filtered water reservoirs uncovered in such a district as this.

Re-examined by Mr. TINDAL ATKINSON: Although he had said the

Company could not raise further capital at less than a little over 3 per cent., this did not affect his valuing the concern on the 2¾ per cent. basis, because that applied to the present capital. The chief causes of the working expenses having lately gone up were the increase in the rates and larger fees paid to the Directors. He still adhered to his idea that the consumption of water could be reduced to 25 gallons per head daily.

Mr. *G. J. Symons*, F.R.S., Secretary of the Royal Meteorological Society, produced extensive tables containing rain records of the district for a considerable number of years past, from which it appeared that the average was about 31 inches. The error Mr. Burstal made last year in giving the rainfall, was due partly to mistakes in casting, and partly to his having taken a series of dry years.

Witness, in cross-examination by Mr. Balfour Browne, said if the available rainfall in three dry years was only 7·35 inches, instead of 9·8 inches, there must have been an exceptional drought, such as it was not the ordinary practice of the engineers to provide for. Witness was also questioned with a view to showing that he had unfairly omitted to include some records; but no admission of importance was elicited.

Mr. *S. Wood*, of Messrs. Lass, Wood, and Co., handed in a voluminous set of tables relating to the accounts of the Company. At the end of 1897, there was a surplus of £5499 excess profit, which the Company could not divide. The capital expenditure shown was £97,645; but making certain necessary adjustments, brought the sum to £92,000 odd. As the capital authorized was £95,000, some £2000 odd therefore remained to be expended. The percentage of expenditure to income had gone up from 33·73 in 1896, to 34·33 in 1897. This was due to an exceptional item of £101, the increase in rates and taxes, Directors' fees, and maintenance and renewals—principally the latter.

Cross-examined by Mr. Balfour Browne: The tables showed a steady increase of working expenses in late years, and decrease of profit in proportion to income. Except in 1897, dividends had been paid in full without deduction of income-tax. If this had not been done, the £5499 the Company now possessed would have been increased by £2000.

Some discussion then took place between Counsel relative to the date from which the Corporation were to take over the concern, and as to payment of any expenditure that might be incurred after that date. Eventually it was decided to fix Dec. 31 last as the date of transfer; and it was agreed to leave to Mr. Wood the adjustment of the expenditure of the Company since.

Mr. *Henry Rofe*, M.Inst.C.E., examined by Mr. Lloyd, said the works of the Company were capable of affording an ample supply. The water was efficiently filtered. Assuming the rainfall was as given by Mr. Symons, the Company were capable of earning their dividends in perpetuity, and of maintaining the present margin. He had not therefore thought it necessary to make any deduction in his valuation for additions that might be necessary. He regarded this as an exceptionally valuable property; and he had therefore capitalized it on the 2¾ per cent. table, which gave 36·36 years' purchase. The claim under the head of conversion of mortgages, he held to be perfectly fair and equitable. He valued the concern in the same way as Mr. Burstal; bringing out a total of £242,800.

Cross-examined by Mr. Balfour Browne: If the rainfall was 7·35 inches, as was the case over three dry years, the total supply would be 473,156 gallons daily, which, with 64,000 gallons from the springs, would be 537,000 gallons per day. This, at 25 gallons per head, meant a supply for only 21,487 persons, while the actual population now was 26,600. If that were so, his valuation should be modified by deducting the amount necessary to enable them to maintain their dividends. If the conversion of the mortgages took place, it would mean that the people of Harrogate would have to go on paying the £500 which the Company would save, until the Company got to the limit of their reserve, when they would have to reduce their charges by this amount. He could not say that the Company had lost their chance of converting by not doing it before the notice to treat was given, and that therefore no claim could be founded on it—that was a legal matter. The amount which would be required to supply the deficiency in storage for one year, might be £10,000. He did not agree that, with this additional storage, there would be a deficiency over three dry years.

Mr. *E. M. Eaton*, Assoc.M.Inst.C.E., examined by Mr. Lloyd, generally supported the preceding evidence. It was true that in 1893 the Company were 30 million gallons short of their full storage; but this deficiency was at the time in course of being supplied. In his valuation, he agreed with Mr. Burstal. The 2¾ per cent. basis of valuation, he thought, was proper in works of this kind, and having regard to the great change that had occurred in the value of money. The claim for the conversion of the mortgage debt he justified on the ground that, as the Company were being forcibly dispossessed of the right, they should be fully remunerated.

Cross-examined by Mr. Balfour Browne: On the basis of a rainfall of 7·35 inches, the average of three dry years, as Counsel suggested, the quantity available daily was 473,156 gallons, or 172,701,940 gallons in a year, which, *plus* 23,360,000 gallons (the quantity derivable from the springs, at 64,000 gallons daily), gave 196,061,940 gallons as the quantity which would be available in the first year. The total actually supplied in 1897 was 338,111,764 gallons; so that there was a deficiency of over 142 million gallons. On the three dry years to which the 7·35 inches applied, the deficiency, supposing there was no waste, would be trebled. Allowing that the basis of the calculation was correct, he further agreed that the £10,000 which Mr. Rofe suggested as necessary to supply the deficiency of one year—supposing that this figure was correct—would have to be multiplied by three.

Mr. Fenwick remarked that there was no evidence yet that there was any such deficiency.

Mr. Balfour Browne said they had not heard his case. There had not been any difficulty so far; but he pointed out that in the very dry year of 1893, the population was much smaller, and the consumption consequently much less than it was now.

Witness, in further cross-examination, said he should not line the reservoir with concrete, because he regarded concrete as most unsatisfactory where it was exposed to the atmosphere on or about a water-line. He should use Staffordshire blue bricks or dressed stone, which would cost about 5s. a yard. He strongly supported the payment of the 10 per cent. allowance for compulsory purchase—particularly in so sound a Company as the present.

Re-examined by Mr. Lloyd: Mr. Balfour Browne, in his calculations as to the storage required, dealt with the daily average; and it seemed to witness that a trap was concealed somewhere in this, though he could not off-hand say just where.

Mr. Lloyd: Did you ever hear of 600 days' storage?

Witness: No, never.

If my friend is right, is that not what he wants?—That is entirely as it appeared to me at first. With the rainfall which this district enjoys, 200 days would amply suffice to take the Company comfortably over three years; but 600 days' storage would be utterly impossible. The part of England where they had to provide the maximum amount of storage was in Lincolnshire, where the available rainfall was from 2½ to 3 inches. There they provided 320 days' storage, which was the largest quantity he had ever heard of.

Mr. *Thomas Wainwright*, surveyor, valuer, and civil engineer, said the works of the Company were in good condition; the only fault that could be found in them being that the pitch at one of the reservoirs had slightly slipped. This, however, could be repaired at a cost of about £120. The expenditure on maintenance had been quite as much as was necessary. He had valued on the same basis as preceding witnesses; and he, too, held that he was justified in taking the high multiplier, by the condition of the money market, the state of the works, and the statements as to the continuity of the supply. As to the 10 per cent. allowance, this he held to be perfectly fair. It was invariably claimed; and, as far as his experience went, both as Arbitrator and Umpire, it had never been disallowed.

Mr. Balfour Browne: When you make an award, are you in the habit of showing how the award is made up?

Witness: Never.

Mr. *Richard Horsfall*, surveyor and valuer, gave similar evidence as to the condition and worth of the undertaking. As showing the value of money, he stated that the Halifax Corporation had recently raised loans at 2½, 2¾, and 3 per cent. He held that the valuation of the Company's dividends on the 2¾ per cent. basis was quite equitable.

Mr. *R. S. Henshaw*, examined by Mr. Lloyd, said he became Engineer to the Water Company in October last. He had inspected the mains at a number of places, and always found their condition satisfactory. The total length of mains was 47 miles 82 yards. He had discovered a number of leakages, some in the water-fittings, and others in the mains. He had been able to reduce the consumption, so that taking the three weeks ending Dec. 16 last it was each week lower than in any of the previous weeks of the year by 208,000 gallons. It was lower also than in the corresponding weeks of 1896 by 513,000 gallons. He was now preparing a list of the renewals and extensions of mains since 1888, which he would hand in when complete. The yield of the Harlow Moor and Tank springs, taking an average over 1896, was 64,000 gallons daily. This information he took from a book kept by the Company's late Engineer, Mr. Dixon. Witness, on Nov. 19 last, between midnight and 4 a.m., made two tests, with a view of ascertaining the leakage that was going on. All the water running into No. 1 reservoir he turned into No. 2, and supplied the town from No. 1 reservoir. He had a peg driven in at 12 o'clock at the exact level of the water. Then he measured how much the water sank each hour, and calculated the number of gallons. He cut off the supply to the station and to the Victoria Baths; and he had a man at Star Beck to take the quantity used there, which he deducted from the amount that left the reservoir. The result was that, out of a total consumption in the four hours of 45,845 gallons, he could not account for 39,709 gallons. At the high-pressure reservoir, the surface of the water was so great that the sinking of the level in an hour could not be perceived, so he had a meter fixed on the main. This showed that 2600 gallons went, none of which he could account for.

Cross-examined by Mr. Balfour Browne: He had examined eight mains; and he gave the positions of them all. He was not aware that six of them were new. Of the mains laid before 1889, he had inspected three pieces, and found them to be good. He could not give the actual figures from which he made his calculations as to the loss from waste, when the tests were made. He was not present himself. He had a man to read the eighths of inches by which the water fell. In one hour, the water sank ⅝ inch; and in the four hours, 2½ inches.

Mr. Balfour Browne: You have taken the total amount at about 45,000 odd gallons. The gauge at Star Beck showed 6145 gallons used; is it the deduction of one from the other that gives you the waste?

Witness: Yes.

Do you think that is right? You have cut off one consumer out of 26,000, and called the rest waste?—Excuse me, I cut off the baths and Harrogate station as well.

You cut off three customers out of 26,000.

Mr. Fenwick: Remember it was night time.

Mr. Balfour Browne (to witness): Do you mean to say no water is used in a town like Harrogate between midnight and 4 a.m.?

Witness: The quantity is very slight.

Do you mean to say the water-closets are not used? Is it not a fact that the cisterns are being filled up between midnight and 3 a.m.?—Not that I know of. The figures at each hour were: Midnight to 1 a.m., 13,688 gallons run off, 1130 gallons used at Star Beck—balance 12,558 gallons; 1 a.m. to 2 a.m., 10,950 gallons run off, 610 gallons used at Star Beck—balance 10,340 gallons; 2 a.m. to 3 a.m., 10,950 gallons run off, 1650 gallons used at Star Beck—balance 9300 gallons; 3 a.m. to 4 a.m., 10,266 gallons run off, 2755 gallons used at Star Beck—balance 7511 gallons.

Does it not occur to you that, from these very figures, it is obvious that it is not all waste? The amount begins at 12,000 gallons and goes to 7000 gallons. If it had been waste, the figures would have been the same?—The calculation is made on the 7511 gallons.

Is the 39,000 odd gallons the summation of the four figures you have given us?—Yes.

Then it is not all waste?—No; not a slight portion of it. Continuing, witness said the average supply from the springs in 1896 was 64,000 gallons daily; but the minimum was 13,200 gallons. If 1896 was a wet year, the springs would give less in a dry one—perhaps 50,000 gallons a day. In the period in 1897 when there was a saving by comparison with previous weeks of 208,000 gallons, he admitted that the gauge was out of order to the extent of $\frac{1}{16}$ inch, which would mean 12,000 gallons a day; and if it had been wrong over the whole week, it would have accounted for 84,000 out of the 208,000 gallons.

Re-examined by Mr. TINDAL ATKINSON: He had not had mains opened for the special purpose of inspecting them; nor had the Corporation made application to have them laid bare for that purpose. Renewal of the mains had been going on since October; but not more than half a mile had been attended to. In order to properly check waste, it was necessary to have a house-to-house visitation; and there had not been such a visitation in his time. The most wasteful period during the night, with regard to leakage, was between 3 a.m. and 4 a.m. The unaccounted-for quantity in that period in his test was 7511 gallons, which practically represented the leakage going on, and which should be taken over the 24 hours.

Thursday, Jan. 20.

Mr. *J. E. Powell*, land agent and surveyor, of Harrogate, and a Director of the Company, said 1893, from the water-works point of view, was the driest year they had ever known. Beaver Dyke reservoir, then in course of construction, was 30 million gallons short of its full capacity; and this capacity was still further reduced by the Engineer, without the knowledge or consent of the proprietors, letting down the water 2 feet in order to prepare for the pitching. The Directors, in order to safeguard the consumers, pumped water from Oak Beck; but as a fact it was not required, and the town was never short of water. In January, 1894, the Beaver Dyke reservoir was completed and filled. Witness testified to the development of Harrogate, the houses being chiefly large. Practically the shares of the Company were not dealt in. The new Engineer had effected a considerable reduction in the consumption.

Cross-examined by Mr. BALFOUR BROWNE: The water-fittings for the past 10 years had been stamped and tested by the Company, so that half the fittings would now have been so dealt with.

Mr. *Henshaw*, recalled, produced a list of the mains, showing that since 1888 about half the existing ones had been relaid, either as extensions or replacements.

The matter of the compensation to be paid to the servants of the Company not taken into the Corporation service was then raised; but it was decided not to go into the question in the present proceedings.

This closed the evidence for the Company.

Mr. BALFOUR BROWNE then addressed the Court on behalf of the Corporation, and called witnesses in support of his case. At the conclusion of the evidence (a report of which will appear next week), the proceedings were adjourned until Saturday next, the 29th inst., when Counsel will deliver their speeches.

THE FIGHT FOR THE TODMORDEN WATER-WORKS.

The Provisional Agreement with Rochdale and the Financial Outlook.

Negotiations have been proceeding between the Rochdale and Todmorden Corporations in order to try to effect a compromise in regard to the struggle upon which they have entered to obtain possession of the Todmorden Water Company's works. Although no satisfactory solution of the difficulty has yet been found, strong hope is entertained that a settlement will be arrived at.

The Rochdale Corporation Water Committee have issued a report in which they seek to justify their action in connection with this question. They first give an account of the Rochdale Water-Works from the time the Corporation took over the supply from the old Company, and show conclusively how the present need for increasing the supplies has been anticipated for many years past. Regarding the purchase of the Todmorden works, the report states that the provisional agreement for the transfer of the undertaking was entered into between the Corporation and the Company in October last. The consideration for the sale and purchase is to be the issue to the holders of 5 and 6 per cent. preference shares of annuities of £5 and £6 respectively for every £100 of such capital, and to the holders of ordinary shares of annuities at the following rates for every £100 of such capital: For 1898, £3; 1899, £4; 1900, £5; 1901 and every subsequent year, £6. The Corporation have also to pay, on the completion of the purchase £1750, to be applied by the Directors in compensating their officers, and in paying the costs incurred in winding up the affairs of the Company. If the works are acquired, and the supply of water to Todmorden does not increase, the construction of new reservoirs will, the Committee say, be delayed accordingly; while, if there is an increased supply of water to Todmorden, Rochdale will get an increased revenue from the works. As to the financial result of the purchase, the Committee remark that it will be within the knowledge of the Council that the water-works deficiency is being reduced by about £1000 a year. If the Company's undertaking is purchased on the terms agreed upon, it practically means that for the next two or three years the Corporation will not be able to continue to reduce the deficiency on water-works account; but at the same time it must be borne in mind that no material increase of the rates from this department will take place—there will merely be a postponement of the time when the deficiency will be cleared off. A table is next given showing the estimated deficiency on the present works, the estimated deficiency owing to the purchase of the Todmorden works, and the total deficiency. According to this, the total deficiency in 1899 will be £3254; by 1905, this will have been reduced to £338; and in the year following there will be a surplus of £532. The only cash payment to be made by the Corporation is the £1750 before mentioned. It is intended also to repay the Company's debentures, amounting to £11,000; and the Corporation will borrow the money for this purpose at the current rates they are for the time being paying for all moneys borrowed by them for other purposes. Included in the report is one by Mr. James Mansergh on the value of the Todmorden works. He states that, after a careful perusal of the published accounts for 1892 to 1896, he has come to the following conclusions: (1) That the income has increased at a very satisfactory rate, and that the expenditure is relatively low. (2) That, assuming the growth of the income during the next few years to be at a rate one-third less than that of the past five years, and the expenditure to be one-fourth more, the Company will be earning enough in six or seven years time to pay a dividend of 7 per cent. on the ordinary capital, the full authorized dividends on the preference shares, and sufficient to pay the debenture interest. Mr. Mansergh's estimate for the whole of the new works sought to be authorized by the Bill "including the purchase of the necessary property and contingencies" is £395,000; and by the Bill power is sought to borrow a sum of £15,000 for mains and extensions estimated to be required for a period of fifteen years over the Corporation area of supply. The report concludes with a condemnation of the suggested alternative plans of increasing the Rochdale supply; and in this the Committee have the support of Messrs. Mansergh, Hawksley, and Rofe.

A meeting of property owners, convened by the Property and Ratepayers' Defence Association, was held yesterday week, to discuss the scheme. There were only between sixty and seventy persons present; and a resolution was passed in opposition to the purchase.

On Thursday, a largely-attended meeting of property owners and ratepayers was held at Todmorden, to consider the recommendations of the Town Council that they should promote a Bill for the purchase of the Water Company's reservoir at Ramsdenwood, to acquire additional sources of water supply, and construct new water-works, and further, to consider whether they should oppose the Rochdale Bill for the acquisition of the same reservoir and rights. On the motion of the Mayor (Mr. Caleb Hoyle), the recommendations were adopted, except the one for purchasing the water-works, which was adjourned pending the result of a poll of the Rochdale ratepayers.

CROWBOROUGH DISTRICT WATER COMPANY.

An Extraordinary General Meeting of this Company was held last Tuesday, at the Offices, Tokenhouse Buildings, E.C.—Mr. S. R. DENNIS in the chair—for the purpose of passing a resolution reducing the number of Directors to three.

The SECRETARY (Mr. A. C. Tulk) having read the notice convening the meeting,

The CHAIRMAN, in moving the resolution above referred to, said the meeting was only a formal one; but he was pleased to meet the shareholders, as it afforded him an opportunity of giving them some information as to the present satisfactory position of their undertaking. The Crowborough District Water Act received the Royal Assent on the 6th of August last, since which date no time had been lost in making a start with the works. Prior to the passing of the Bill, negotiations had been going on with the representative of the Marquis of Abergavenny, K.G., the Lord Lieutenant of the county, for the acquiring of the necessary land. These negotiations had been brought to a successful issue; the Company having completed the purchase of the freehold site for the well and pumping-station. The land being in the vicinity of the London, Brighton, and South Coast Railway Station, it was particularly well situated. It was proposed to erect also the Manager's residence and Company's offices on the site. It was necessary to purchase further land for the high and low service reservoirs, and also for the proposed water-tower. The Marquis of Abergavenny's large estate, of about 8000 acres, contained the very sites the Company desired; and he was glad to say an agreement had been entered into for the Company to obtain them on reasonable terms. Having dealt with the sites, he went on to say that the works were being energetically pushed forward. The well had been commenced, and it was anticipated that within the next month or six weeks a large volume of water would be obtained. The spot had been most carefully selected by the Company's geological expert, Mr. C. W. Hawkins, of the Government Geological Survey, and it was in similar strata—viz., the Ashdown Sands—to the well of the Cranbrook District Water Company, of which he (Mr. Dennis) had the honour to be also Chairman. A large quantity of mains had been delivered; and the laying of them would commence in a few days. It was expected that in eighteen months from now the Company would be supplying water. In conclusion, he said the Company were much indebted to their Engineers (Mr. C. O. Blaber and Mr. G. Perryn, Assoc.MM.Inst.C.E.) for their valuable advice; and he added that it was under the supervision of the latter gentleman that the Cranbrook Water-Works were carried out.

Mr. BARNES seconded the motion; and it was passed unanimously.

The Typhoid Epidemic at Maidstone.—In the "JOURNAL" last week, it was stated that the Maidstone Urban District Council intended applying to the Local Government Board for a postponement of the inquiry into the cause of the recent epidemic of typhoid fever, fixed to be opened on the 31st inst. The application has been made, with the result that the Board have declined to comply therewith, on the ground that insufficient reason has been shown for deferring the investigation. It will be conducted by Mr. J. S. Davy, a barrister, who, as already mentioned, will have the assistance of two of the Board's Inspectors. The Local Authority and the Water Company will, we believe, both be represented by Counsel.

The Swansea Corporation and the Gas Company's Bill.—According to a report prepared by the Town Clerk of Swansea, certain of the powers sought by the Gas Company in the Bill which they are promoting in Parliament are "opposed to the best interests of the borough." Among other points to which he calls attention, is the proposal of the Company to acquire additional land to the extent of 10 acres. Remembering that the existing extensive works only occupy 5½ acres of land, he thinks that the real objects of the promoters in asking for this power should be disclosed, and proper restrictions imposed. The Town Clerk also comments on section 9 of the Bill, which deals with the standard price to be charged for gas, and which seeks to provide that the Company may increase or reduce the price above or below the standard price, subject to a reduction or increase in the standard dividend payable on their consolidated stock. The standard price prescribed by section 28 of the Company's Order of 1888 is: Within the borough, 3s. 6d. per 1000 cubic feet; and outside, 5s. The price at present charged to private consumers within the borough is 3s. It therefore follows, remarks the Town Clerk, that, even if the present price were maintained, the Company would be entitled, without any further reduction whatever, to increase their standard dividend on the consolidated stock by 15s. per cent. per annum. He therefore considers this clause to be most objectionable, and one that should be opposed. At the meeting of the Town Council last Wednesday, a Committee was appointed to join with the Town Clerk in preparing a petition against the Bill.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

Carburetted water gas for Edinburgh still holds the field of public attention; but the subject is not being taken seriously by the community. There were three letters published in the "Scotsman" on Tuesday; and the Editor thought fit to insert a leading article on the matter on Thursday. Only one of the letters was signed, the other two being anonymous; and this makes me incline to the belief that they were written, not from conviction, but for some interested purpose. The first letter, for instance, was exceedingly up to date; containing, as it did, the protest by the sixteen medical men of Darlington. Whoever wrote it is manifestly quite familiar with what is going on in connection with gas supply. The other anonymous writer had special information supplied to him, which he understood to be absolutely correct, to the effect that water gas is now being manufactured at the rate of about 1 million cubic feet per day, which is about one-fourth of the output. He, too, is no ordinary citizen. In his leader, the Editor asks whether the Gas Commissioners have nothing to say in reply to what is described as "very like a charge of distinct breach of faith on the part of the Commissioners." He calls for an explanation without delay. Well, the Commissioners hold their monthly meeting on Monday; and they will then, doubtless, refer to the subject. The Editor of the "Scotsman" is in too much haste. In a matter of this sort, it takes some time to move the body who should give the answer. This being so, the question arises whether the letter should have been written in reply to the gentleman, stating that water gas was not being introduced into the mains, until it had been dealt with by a Committee. It is to be observed that it was water gas, and not carburetted water gas, which, it was said, was not being introduced into the mains. There is a distinction there, without much difference; and if this should turn out to be the explanation, I am afraid it will not be well received.

There is another matter connected with the sporadic agitation on the subject, which I cannot pass over. It is that the only communication from the other side appeared, not in the "Scotsman," but in the "Edinburgh Evening News." It was a letter, published on Wednesday, from Mr. J. Arnold Norcross, who wrote on behalf of Messrs. Humphreys and Glasgow, pointing out that the correspondents had been misinformed either as to the gas to be supplied, or as to its chemical and physical properties. He then gave an "absolutely incontrovertible statement," which was divided into five heads. The first was that there was absolutely no chemical element or combination of elements in carburetted water gas not found in ordinary coal gas. The second was that the gas was used in the places enumerated, in Europe and America; and the question was asked: "Could stronger proof possibly be desired by the human mind of the comparative harmlessness of a commercial product, than this constantly increasing use of it by millions of citizens of the most civilized nations?" The third point related to the smell of carburetted water gas. In the fourth, it was held that the heating power of the gas was the same as that of coal gas of equal illuminating power; and the final statement was: "There is no reason at all that this gas should, in Edinburgh, be either more harmful or less of a benefit to the public than it is in other prominent cities of the realm." There the question rests. As I have said, the public are not greatly concerned in the matter, though there are a few nervous people. One of these was sent to me the other day by a gentleman whom he had asked if the carburetted water gas would be safe to use for cooking purposes, or whether the poisonous ingredients in it would not affect the meat. He was also anxious to know if the Gas Commissioners had statutory authority to supply this new gas. As to his first question, I assured him that if his burners were sufficient to consume the water gas properly, the resulting gases from it would be as inocuous as they would from any substance. "I am not sure of that," was his retort; so that he was not convinced. Regarding his second inquiry, I referred him to the Commissioners' Act of Parliament. On looking at it myself, I find that it simply empowers the Commissioners to supply gas for lighting purposes. It is thus quite legal for them to send out carburetted water gas.

The Corporation of Glasgow have, on the advice of Mr. W. Foulis, their Gas Engineer, entered into communication with the Trustees of Sir George Campbell, of Garscube, for the acquisition of ground upon which to extend the chemical and gas works at Dawsholm. A Committee of three members of the Council, along with Mr. Foulis, have been appointed to continue the negotiations, and to report. Bailie Cleland said he hoped that the Gas Committee would take into consideration, before extending the chemical works, the nuisance arising from the smells emitted from them. They were at all times bad, but during the past month the fumes and odours had been particularly offensive; and the inhabitants of the neighbourhood complained very much about them. Mr. R. M. Mitchell, the Convener of the Gas Committee, gave the assurance that any extension they made would not be of an objectionable nature. The Council then grappled with the subject—surely a somewhat small one for the Council of the Second City of the Empire to bother themselves about—of providing a badge for gas collectors and meter inspectors. The Gas Committee sent a recommendation, by a majority, that no badge be provided. It was moved in the Council, however, that a cap with initial letters be furnished to the men. The arguments in support of the motion were that thieves might get into houses on the pretext that they were employees of the Gas Department; that householders were liable to a fine of £5 if they obstructed a gas officer; and that in the Water Department officers wore uniform. It was admitted that no serious case calling for the precaution had arisen. Mr. Mitchell stated, on the other side, that the men disliked the proposal to make them wear a badge. Nobody was asking for it. He, however, agreed to take the subject back, and re-consider it. It is scarcely likely that fraud would be attempted by anyone purporting to be a gas collector or meter inspector. A collector would be obliged to give a receipt, upon Corporation paper, which a thief would scarcely be at the expense of providing; and he would thus be stopped on the threshold of his adventure. A meter inspector requires to carry a book, which, again, a thief would hardly be able to procure, properly marked. It is not these men whom there need be any fear of a criminal counterfeiting; it is more likely to be the bogus burner man, who can start work with a sixpence worth of

GAS AND WATER COMPANIES' STOCK AND SHARE LIST

Referred to on p. 170.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
590,000	10	Oct. 14	10½	Alliance & Dublin 10 p. c.	24—25	..	4 4 0
100,000	10	"	7½	Do. 7 p. c.	16½—17½	..	4 5 8
300,000	100	Jan. 3	5	Australian 5 p. c. Db.	105—107	..	4 13 6
200,000	5	Nov. 11	6½	Bombay, Ltd.	6¾—7¼	..	4 9 7
40,000	5	"	6½	Do. New, £4 paid	5—5½	..	4 14 6
380,000	Stk.	Aug. 27	12	Brentford Consolidated	300—305	..	3 18 8
240,000	"	"	9	Do. New	227—232	..	3 17 7
50,000	"	"	5	Do. 5 p. c. Prf.	145—150	..	3 6 8
159,375	"	Dec. 15	4	Do. 4 p. c. Db. Stk.	134—138	..	2 18 0
220,000	Stk.	Sep. 15	11½	Brighton & Hove Orig.	275—280	..	4 2 3
308,820	"	"	8½	Do. A. Ord. Stk.	203—205	..	4 2 11
933,500	Stk.	Aug. 27	5	Bristol, 5 p. c. max.	130—135	..	3 14 1
420,000	20	Sep. 30	11½	British	56½—57½	..	3 18 3
50,000	10	Aug. 27	11½	Bromley, Ord. 10 p. c.	25—27	..	4 5 2
71,000	10	"	8½	Do. 7 p. c.	20—22	..	3 17 3
500,000	10	Oct. 14	6	Buenos Ayres (New) Ltd	9⅞—10¼	+¼	5 17 1
98,122	Stk.	Dec. 30	4	Do. 4 p. c. Db. Stk.	96—98	..	4 1 8
150,000	20	July 15	8½	Cagliari, Ltd.	30—32	..	5 3 1
100,000	10	Sep. 30	8	Cape Town & Dis., Ltd.	17—18	..	4 8 11
50,000	50	Nov. 2	6	Do. 6 p. c. 1st Mort.	59—61	..	4 18 5
550,000	Stk.	Oct 14	13½	Commercial Old Stock	340—345	..	3 18 3
300,750	"	"	10½	Do. New do.	255—260	..	4 0 9
300,750	"	Dec. 15	4½	Do. 4½ p. c. Db. do.	154—157	..	2 17 4
80,000	Stk.	Dec. 15	12	Continental Union, Ltd.	250—255	..	4 14 1
200,000	"	"	9	Do. 7 p. c. Prf.	214—219	..	4 2 2
51,600	Stk	Aug. 27	14	Croydon A 10 p. c.	315—320	..	4 7 6
168,400	"	"	11	Do. B 7 p. c.	252—257	..	4 5 7
535,000	Stk.	Aug. 12	5½	Crystal Palace Ord. 5 p. c.	137—140	−1½	3 15 0
60,000	"	"	5	Do. 5 p. c. Prf.	140—143	..	3 9 11
486,090	10	July 29	11	European, Ltd.	26—27	..	4 1 6
354,060	10	"	11	Do. £7 10s. paid	18½—19½	..	4 4 7
5,896,590	Stk.	Aug. 12	12½	Gaslight & Coke, A, Ord.	315—318	+2	4 0 2
100,000	"	"	4	Do. B, 4 p. c. max.	113—118	..	3 7 10
665,000	"	"	10	Do. C, D, E, 10 p. c. Prf.	320—325	..	3 1 6
30,000	"	"	5	Do. F, 5 p. c. Prf.	150—155	..	3 4 6
60,000	"	"	7½	Do. G, 7½ p. c. do.	222—227	..	3 6 1
1,300,000	"	"	7	Do. H, 7 p. c. max.	204—209	..	3 7 0
463,000	"	"	10	Do. J, 10 p. c. Prf.	319—324	..	3 1 8
476,000	"	"	6	Do. K, 6 p. c. Prf.	185—190	+3	3 3 2
1,061,150	"	Dec. 15	4	Do. 4 p. c. Db. Stk.	138—141	..	2 16 9
294,850	"	"	4½	Do. 4½ p. c. do.	155—158	..	2 16 11
908,000	"	"	6	Do. 6 p. c. do.	205—210	..	2 17 1
70,000	10	Oct. 28	8	Hongkong & China, Ltd.	14—15	..	5 6 8
3,800,000	Stk.	Nov. 11	10	Imperial Continental	216—221	+1	4 10 6
376,400	100	Aug. 3	4	Do. 4 p. c. Dbs. Red.	99—102	..	3 18 5
473,600	Stk.	Aug. 12	3½	Do. 3½ p. c. Db. Stk.	104—107	..	3 5 5
					* Ex div.		

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
75,000	5	Dec. 15	6	Malta & Medn., Ltd.	5½—6	..	5 0 0
560,000	100	Oct. 1	5	Met. of Melbourne } 5 p. c. Db. / 4½ p. c. Db.	112—114 / 109—111	..	4 7 8 / 4 1 1
250,000	100	"	4½				
541,920	20	Nov. 11	5	Monte Video, Ltd.	15—16	..	6 5 0
150,000	5	Nov. 26	8	Oriental, Ltd.	8½—8¾	..	4 11 5
135,000	5	"	8	Do. New, £4 10s. pd.	7—7½	..	4 16 0
15,000	5	"	8	Do. do. 1879, £1 pd.	1½—2	..	4 0 0
60,000	5	Sep. 30	7	Ottoman, Ltd.	4½—5	..	7 0 0
420,000	100	Nov. 2	6	People's Gas } 1st M. Bd. / of Chicago } 2nd do.	104—109 / 103—108	..	5 10 1 / 5 11 1
500,000	100	Dec. 1	6				
250,000	10	Sep. 30	10	San Paulo, Ltd.	16—17	..	5 17 3
135,000	Stk.	—	10	Sheffield A.	250—253	..	3 19 0
209,053	"	—	10	Do. B.	250—253	..	3 19 0
447,427	"	—	10	Do. C.	250—253	..	3 19 0
5,475,000	Stk.	Aug. 12	5½	South Metrop., 4 p.c Ord	144—147	+1	3 11 5
1,416,667	"	Jan. 13	3	Do. 3 p. c. Db. Stk.	105—108*	..	2 15 7
60,000	Stk.	Sep. 15	12	Tottenham and } A. / Edmonton } B.	285—295 / 205—215	..	4 1 4 / 4 3 9
60,000	"	"	9				
182,380	10	Dec. 20	7	Tuscan, Ltd.	13½—14½	..	4 16 7
149,900	10	Jan. 3	5	Do. 5 p. c. Dbs. Red.	100—103	..	4 17 1
				WATER COMPANIES.			
746,164	Stk.	Dec. 30	10½	Chelsea, Ord.	335—340	..	3 1 9
150,000	"	"	5	Do. 5 p. c. Prf.	177—180	..	2 15 6
160,000	"	"	4½	Do. 4½ p.c. Pf. Stk., 1875	157—160	..	2 16 3
175,785	"	Sep. 30	4½	Do. 4½ p. c. Db. Stk.	160—165	..	2 14 6
1,720,560	Stk.	Oct. 14	7½	East London, Ord.	233—237	..	3 3 3
654,740	"	Dec. 30	4½	Do. 4½ p. c. Db. Stk.	162—165	..	2 14 6
390,000	"	"	3	Do. 3 p. c. Db. Stk..	105—107	..	2 16 1
700,000	50	Dec. 15	7½	G'd Junct'n, 10 p. c. max.	122—127	..	2 19 0
295,000	Stk.	"	4	Do. 4 p. c. Db. Stk.	147—152	..	2 12 8
708,000	Stk.	Aug. 12	13	Kent	362—367	..	3 10 10
160,000	"	"	7	Do. New, 7 p. c. max..	215—220	..	3 3 7
1,043,800	100	Dec. 30	10	Lambeth, 10 p. c. max.	307—312	+2	3 4 1
406,200	100	"	7½	Do. 7½ p. c. max..	227—232	..	3 4 8
350,000	Stk.	Sep. 30	4	Do. 4 p. c. Db. Stk.	147—150	..	2 13 4
500,000	100	Aug. 12	13	New River, New Shares	452—457	..	2 16 10
1,000,000	Stk.	July 29	4	Do. 4 p. c. Db. Stk.	152—155	..	2 11 7
902,300	Stk.	Dec. 15	6	Southw'k & V'xhall, Ord.	165—168	..	3 11 5
126,500	100	"	6	Do. do. 7½ p. c. max.	157—162	..	3 14 1
489,200	Stk.	"	5	Do. do. 5 p. c. Prf.	175—180	..	2 15 6
1,019,585	"	Oct. 14	4	Do. 4 p. c. A Db. Stk.	146—149	..	2 13 8
1,155,066	Stk.	Dec. 15	10	West Middlesex	317—322	+2	3 2 1
200,000	"	"	4½	Do. 4½ p. c. Db. Stk.	162—165	..	2 14 7
					* Ex div.		

burners, and who can, if admitted, wander through the house at will, picking up any valuables he may discover. The gas collector or meter inspector is seldom left unattended; and thus the opportunity for pilfering is not sufficiently great to induce anyone to pretend that he is on that business. As to the risk which the community run of being fined for refusing admission to a genuine official, I should say it is almost non-existent. The book he carries should be a sufficient voucher of his employment.

The Stirling Town Council on Monday resolved to oppose the Bill of the Gas Company. Mr. Yellowlees, who was at one time Provost of the burgh, was the principal speaker. He thought that some of the proposals of the Company were monstrous. I think that two of his statements are little short of that. The one was that the Company proposed to double their capital of £29,000, making it practically £60,000, and then to divide it into two portions; and upon the one £30,000 they were to take power to pay a dividend of 10 per cent., while upon the remainder they were to pay a dividend of 8 per cent. "That was to say," he exclaimed, "they wanted statutory powers to charge 18 per cent. upon their present capital." This second statement had reference to the fixing of the standard price of gas at 4s. per 1000 cubic feet, and the proposal to add ¼ per cent. to the dividend for every penny reduction of price. At the present rate of charge—3s. 4d. per 1000 cubic feet—he said they would be entitled to over 21 per cent. This is the sort of argument which has been used all through the gas agitation in Stirling. It is altogether a begging of the question to assume that the capital is only £29,000, because it has been proved, quite satisfactorily, that the value of the undertaking is about £60,000. Mr. Yellowlees postulated that they did not in the least want to deprive the Gas Company of their legitimate profits. If he had his will he would deprive them, not merely of their profits, but also of their capital. The shareholders have paid the £60,000; and if they took the money out of revenue instead of formally issuing shares, the situation is the same. To make them fix their capital at £29,000 now, means that they are to forego the other £30,000 or so which they have expended on the works and plant. There is great profession in the Council of a desire to avoid a parliamentary fight; but it will not be prevented if the Town Council pursue their present tactics. And then, of course, if there were no contest, some members of the Council would lose their visit to London. It is about as certain as anything can be that the fight will go on.

The Forfar Gas Corporation have, by a majority of nine to six, rescinded a minute which stood on their books, and which required all contractors with them to pay the standard rate of wages to their workmen, and to conform to the bye-laws laid down by the various Trade Unions. Is this the shadow of coming events in other corporations?

The Largs Gas-Works are to remain the property of the Gas Company. The Police Commissioners were moving for a transfer; but when the subject was before them last week, the voting was equal. It requires a two-thirds majority to adopt the Burghs Gas Supply Act, and so the proposal was lost; and in terms of the Act, it cannot be renewed for three years.

The Portobello Gaslight Company, having now been taken over by the Edinburgh and Leith Gas Commissioners, was formally wound up on Wednesday. The shareholders met in Edinburgh. Mr. J. Pollard, the Liquidator, submitted his accounts, which were adopted; and the resolutions declaring the Company to be wound up were then agreed to.

In Dundee there is frequent complaint that the charge for water is so high that trade is injured because of the necessity there is for exercising economy. The matter has been frequently under consideration; and it is so at the present time. On Tuesday, the Water Committee of the Town Council had before them a report on the subject by Mr. George Baxter, the Engineer and Manager; and they directed that it be printed and circulated among the members of the Council. The report states that during the past year 564,486,000 gallons of water were sold by meter. The total supply available from the water-works is 15½ million gallons per day; and as the average daily consumption last year was over 8 million gallons, there is a surplus of nearly 7 million gallons per day, which would be available for sale. No inconvenience would be experienced in the distribution except in one or two isolated instances, if the consumption by meter were trebled. The revenue derived from meter supplies is £16,460. Of this sum, £7500 is contributed by manufacturers, and £3100 by railway companies. It is Mr. Baxter's opinion that manufacturers might use more water if the price were reduced to, say, 3d. per 1000 gallons, as against 7d. at present. He suggests that there should be a sliding-scale, as in most large towns.

The discovery of paraffin oil in the Aberdeen water supply has been the means of directing the attention of the Corporation to the condition of the aqueduct by which the water is conveyed; and in this respect it will doubtless result in benefit to the community. On Thursday, the Water Committee, and other members of the Town Council, made a visit of inspection to the portion of the aqueduct between four and eight miles from the city boundary. The state of matters which was discovered was sufficient to create alarm, though in the view of the Committee it was more reassuring than they had supposed. The aqueduct is of brick; and the Water Committee propose to substitute cast-iron piping for it at various points. This was submitted to the Town Council on Monday, and led to a long discussion, as the outcome of which the Burgh Surveyor has been directed to report as to the cost of laying cast-iron pipes, and as to what he deems to be necessary to prevent further contamination. The proposal to lay iron pipes was, I may say, objected to in the Town Council on account of the fear that it would entail an outlay of from £100,000 to £160,000. It is highly probable, though it is not stated, that the inspection on Thursday arose out of the discussion on Monday; some of the members of the Council being desirous of seeing the condition of things for themselves. The state of affairs was such as can only be accounted for by long-continued apathy on the part of the Water Committee and officials as to the condition of the works under their charge.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Jan.* 22.

Sulphate of Ammonia.—In the early part of the week, the market was quieter, but very firm. Later, there has been renewed activity; and a heavy business has been done at advanced prices. Closing quotations

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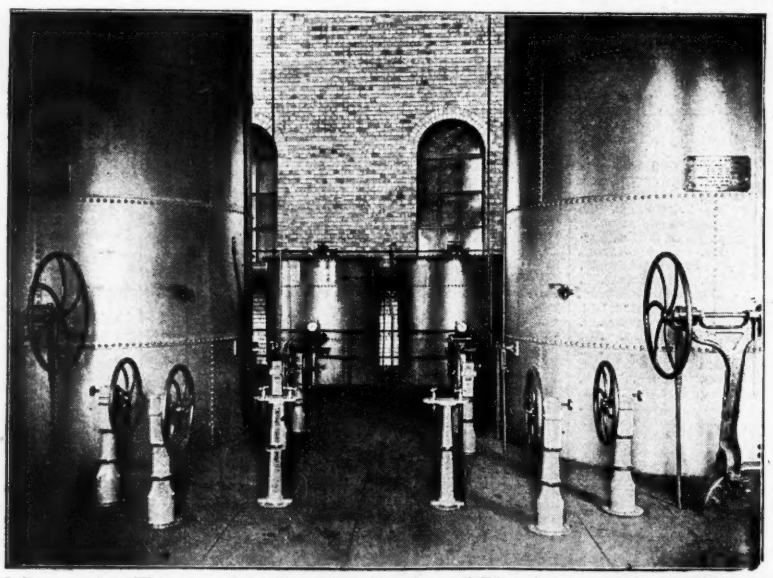

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are £10 to £10 2s. 6d. per ton f.o.b. at the ports. Makers continue to market their output as it becomes available, and find a ready sale at all points. In the forward position, the largest business has been done, at up to £10 January-June, ordinary terms, f.o.b. Leith, and at the same price London (Beckton terms) January-April. At the close, a further advance of 2s. 6d. to 5s. per ton was asked.

Nitrate of Soda remains firm at 7s. 6d. per cwt. for ordinary, and 7s. 7½d. per cwt. for fine quality.

LONDON, *Jan.* 22.

Tar Products.—The low prices of benzols have brought more inquiry; and, after business had been done at 1s. 2½d. for nineties, and 1s. 4½d. for fifties, makers' ideas stiffened; and to-day the market is a shade better. A little more life is noticeable in respect to pitch; and business has been done at the figures mentioned below, although most makers—being well sold, and easy in regard to stocks—are quite indifferent to present market prices. There is still a good inquiry for creosote; and the mild open weather is permitting its use, in various directions, to a much larger extent than is usual at this time of the year. Carbolic acid is firmer, with much inquiry. Anthracene is steady, though no new business of any moment is reported. There is a rumour on 'Change that the Tar Products Sales Committee have made enormous sales during the past month or two. The price of this article is abnormally low, and in many instances will not pay for extraction.

Average values for the week may be taken as follows: Tar, 12s. 6d. to 16s. 6d. Pitch, east coast, 18s.; west coast, 14s. 6d. Benzols, 90's, 1s. 3d.; 50's, 1s. 5d. Toluol, 1s. 8l. Solvent naphtha, 1s. 6½d. Crude, 30 per cent., naphtha, 7½d. Creosote, 2½d.; liquid, 2¼d. Heavy oils, 40s. to 50s., according to gravity. Carbolic acid, 60's, 2s. Naphthalene, nominal, 50s.; salts, 30s. Anthracene, "A," 5¼d.; "B," 4½d.

Sulphate of Ammonia.—There has been considerable excitement in this market during the past week. Very large business has been done at prices commencing at £9 15s., and ending to-day at £10 2s. 6d., less 3½ per cent. at all ports. Singular and surprising fluctuations in value have occurred at some ports, arising from the operations of dealers and urgency of delivery. There are no stocks of sulphate anywhere; and the undoubted advantage of this source of nitrogen is making itself felt among consumers. The value of sulphate is still not more than it should be, compared with nitrate of soda—the latter article also being firm, and likely to be dearer.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—In all the better qualities of round coal, business throughout this district still drags on very slowly for the time of year; house-fire requirements being restricted by the altogether exceptional mildness of the season. Some collieries, in consequence, have even had to go on short time; and others that are working five days per week, are experiencing difficulty in disposing of their output. Stocks remain practically untouched; and this presents a somewhat serious outlook for the ensuing summer. Quoted list rates, however, remain unchanged; the only giving way in prices being in isolated cases, where surplus lots under load are pressed for immediate clearance. Steam and forge coals are moving off fairly well; and with the impending settlement of the engineering dispute, the outlook is more hopeful. Prices for ordinary qualities remain steady at 6s. 6d. per ton at the pit; but with the depression in the house-coal trade, there are plentiful supplies of common round coal offering on the market. Engine classes of fuel also move off pretty freely; some collieries being short of supplies, owing to the limited quantity of round coal now being screened. Though here and there low-priced competition from some outside districts is reported, list prices throughout Lancashire remain unchanged. For shipment, there is a fair inquiry, with 8s. to 8s. 3d. per ton still being obtained for steam coal delivered at the Mersey ports.

Northern Coal Trade.—The coal trade of this district is rather quieter; and prices are on the whole easier. Best Northumbrian steam coals are steady at from 8s. 4½d. to 8s. 6d. per ton f.o.b.; second-class steam coals are 8s.; and steam smalls are 3s. to 3s. 3d. Manufacturing coals are affected by the strike; and there is consequently a lessened use, and weaker prices. The gas coal trade is still very brisk; but though there is a heavy demand, it is less than it was. There is a fair local demand for gas coals; and the quoted prices vary from 7s. 9d. to 8s. 3d. per ton f.o.b. Nothing is yet known as to the result of the tenders for the Copenhagen gas coal supply; but it seems to be expected that the price will be about equal to 7s. 6d. or 7s. 8d. per ton f.o.b. There is no alteration in the price of gas coke.

Scotch Coal Trade.—The market continues strong, with good prospects. An improvement on the present situation is even looked for. While there is an active demand for all classes, ell and splint are in particular request—both for shipment. The prices quoted are: Main, 6s. 9d. per ton f.o.b. Glasgow; ell, 7s. 1½d. to 7s. 4½d.; splint, 7s. 6d. The shipments for the week amounted to 134,059 tons—an increase upon the previous week of 40,963 tons, and upon the corresponding week of last year of 12,735 tons. For the year to date, the total shipments have amounted to 227,155 tons—an increase upon the same period of last year of 7314 tons.

The Sedbergh New Gas Lighting Company, Limited.—At the annual meeting of this Company held on the 17th inst., after providing for a reserve fund, a dividend of 4½ per cent. was declared on the preference shares, and of 7 per cent. on the ordinary shares—the maximum allowed by the Provisional Order recently obtained. This must be taken as very favourable, not only to the shareholders but to the consumers, who were paying 5s. 10d. per 1000 cubic feet for all their gas, seeing that the New Company reduced the price for ordinary illuminating purposes to 5s. 6d., and for cooking-stoves to 4s. 10d. per 1000 cubic feet, and that they also resolved at their meeting to further lower the latter figure to 4s. 6d.

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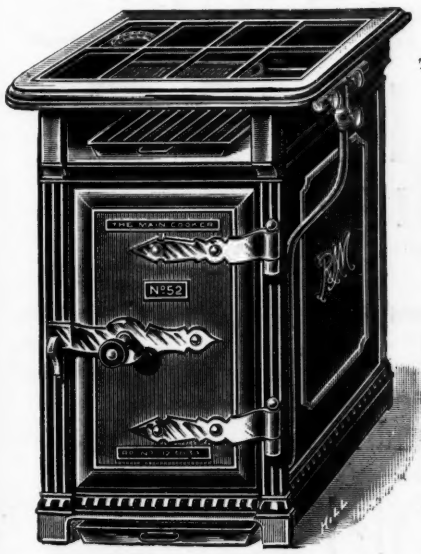

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Extension of West's Stoking Machinery at the Sheffield Gas-Works.—The Sheffield United Gas Company have decided to introduce stoking machinery into the new works now in course of construction at Grimesthorpe; and they have accepted the tender of West's Gas Improvement Company, Limited, for the supply of a complete installation of their latest compressed air machinery, which is to be made suitable for charging and drawing retorts five tiers in height. This is the third retort-house which has been fitted up with West's stoking machinery for the Sheffield Gas Company.

Ashton-in-Makerfield Gas Supply.—At a meeting of the Ashton-in-Makerfield District Council on Monday last week, the Gas Engineer (Mr. J. W. Liversedge) reported that there had been a considerable increase in the make of gas in the past year as compared with 1896. The total quantity produced was 16,415,000 cubic feet, against 15,255,000 cubic feet in the preceding twelve months—an actual increase of 1,160,000 cubic feet. The production is now double what it was nine years ago. The cost per 1000 cubic feet is very much less, as in 1881 it averaged 56·89d., whereas during the financial year to March last it was 32·02d.

The Norwich Corporation and the British Gaslight Company.—At the meeting of the Norwich Corporation last Tuesday, a long report was presented by a Committee who had investigated the financial and general position of the British Gaslight Company as regards their Norwich station. Embodied therein was correspondence which had passed between the Town Clerk (Mr. G. B. Kennett) and the Secretary of the Gas Company (Mr. H. B. Chamberlain) elucidating certain questions raised. These will be dealt with next week. In the meantime, it may be shortly stated that the report was adopted, and authority was given for proceedings to be taken to endeavour to enforce the repayment of any sums charged for interest by the Company upon their capital beyond the sums authorized to be borrowed by their Special Acts, and to incur any requisite expense in obtaining independent tests by specialists of the gas supplied by the Company, or more frequent tests by the Gas Examiner.

The Case of Trade Union Interference at Nottingham.—Messrs. T. Danks and Co., Limited, of Nottingham, who, as our readers are aware, were a few weeks ago the victims of what was generally regarded as unwarrantable interference on the part of a certain Trade Union, have sent to the "Ironmonger," in which the account of their trouble first appeared, the concluding portion of their story. It is as follows: "Owing to the stoppage of all the trades on the job, the work came to a complete stand, and we were asked by the architect to withdraw our men, which we did. The District Trades' Council then proposed terms with the proprietors of the Empire Theatre Company of a substantial fine, and none but society labour to be employed. These terms were accepted; and the men resumed work about Jan. 1. We were then asked to find society plumbers to finish the job; this we declined to do. The Company then arranged to finish the work themselves. In the meantime, we delivered all the material. We may say that, on the result of the case *Allen v. Flood*, Counsel's opinion was against us. In this helpless position we see nothing but to have a combination of employers in each town, then join the Master Builders' Association, who are most in touch with us, and jointly maintain the right of free labour on all jobs."

Cheltenham Water Supply.—The Cheltenham Corporation have applied to the Local Government Board for a Provisional Order to enable them to borrow £30,000 for the purposes of their water-works, on which they intend to spend £8000 at once. A local inquiry on the matter took place last Tuesday.

The Local Government Board and Water Supply in Country Districts.—The Local Government Board have issued another circular with regard to the water supplies in districts partly within the limits of water companies. It was sent to all Town, Urban, and Rural Councils throughout the country. In its main features it was a revised form of the circular previously issued, which was given in the "JOURNAL" for the 28th ult. (p. 1407). The Board point out that, subject to the rights of any water company or other body authorized to supply water in any part of their district, the Council are the body responsible under the Public Health Acts for securing to the inhabitants a proper and sufficient supply of water; and they impress upon them the importance of taking the matter into their serious consideration, with the object of guarding against dangers, the gravity of which has been sufficiently shown by recent examples.

The Purification of the Dee and the Water Supply of Chester.—Some time since a Local Government Board inquiry was held at Chester in regard to an application by the Cheshire County Council and the Chester Town Council for the appointment of a Joint Committee, to enforce the provisions of the Rivers Pollution Prevention Act in the watershed of the Dee. The report of the Local Government Board has been issued; and it shows (to the regret of the Board) that there was considerable opposition to the formation of a Joint Committee from the County Councils of Shropshire, Merionethshire, Denbighshire, and Flintshire. The chief grounds for the opposition were: First, the suggested basis of representation of the Joint Committee; and, secondly, the benefit which it was alleged the Chester Water Company would derive from the action to be taken by the Committee. In regard to the first point, the Board state that they would be willing to consider a proposal that the basis of representation should be rateable value; and concerning the suggestion that the whole scheme was conceived in the interests of the Water Company, the Board point out that the Rivers Pollution Prevention Act of 1876 especially prohibits the pollution of a stream by sewage. Apart altogether, therefore, from any interest which the Water Company might have in the stream, it was an admitted infringement of the law for the District Councils in the upper part of the river to continue to pollute it by sewage; and on this ground, it was very desirable that steps should be taken for the enforcement of the law. Moreover the Inspectors did not regard as justified a contention that the establishment of a Joint Committee would abolish the necessity of a new source of water supply for Chester. While the Board were of opinion that the constitution of a Joint Committee was the best means of dealing with the situation, they were not willing, on the evidence before them, to issue such a Provisional Order as that applied for; and they suggested that a further conference of the County Councils should be held on the subject, at which the Board's Inspectors would be prepared to be present for the purpose of giving such assistance as might be in their power.

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Settlement of the Labour Dispute at the Llanelly Gas-Works.—Taking advantage of a change in the management at the above-named works, which, together with those in the Rhondda Valley, are in charge of Mr. A R. Crawley until the transfer of the undertaking of the Ystrad Gas and Water Company to the Rhondda District Council has taken place, the workmen recently tried to create difficulty by handing in notices. The Gas Workers' Union, however, do not appear to have consistently supported this action, for they ordered their withdrawal; and this was done last Friday.

Water Supply for Welsh Villages.—In the Carnarvon Union, there are fifteen villages or districts, having populations of from 200 to 4000, which are entirely dependent for their water supply upon sources subject to constant pollution; and the problem of securing a proper supply has received the attention of the Gwyrfai District Council for a number of years. In some cases a remedy has been provided, as, for instance, at Llanberis; while operations are now being carried on for supplying the district of Nantlle Vale, comprising three populous villages. So far, however, the Local Government Board have not been disposed to grant borrowing powers to deal with the remaining villages individually, owing, presumably, to their small size. The District Council have therefore decided to carry out one large scheme and effect one loan, in order to deal with the whole of the district at the same time. This will affect nearly 20,000 people, whose means of water supply are at present of the most primitive character.

Chesterfield Water Supply.—A heavy charge was brought against the Chesterfield Gas and Water Board, at the last meeting of the Chesterfield Town Council, by Alderman Wood. The borough generally has been suffering from dearth of water, and Alderman Wood himself stated that he had not had a drop from the mains for seven weeks. In a long speech he dealt with the whole question of the water supply of the borough, and moved a resolution calling upon the Local Government Board to hold an inquiry on the matter. Mr. Wardle, another sufferer from short supply, seconded the proposition. Alderman Clayton, as a member of the Gas and Water Board, defended that body. He assured the Council that they had the subject at heart, and would do their best to supply Chesterfield with water. He hoped the Council would give the Board their confidence by not passing the resolution. This they did; for on it being put, only the mover and seconder supported it. Nearly half of the members had, however, already left the meeting.

Extensions at the Sittingbourne Water-Works.—A new reservoir capable of holding 300,000 gallons, has been constructed for the Sittingbourne Water-Works at Keycol Hill, about two miles from the town. Powerful engines and pumping machinery have also been introduced; the total cost amounting to £6000.

Water-Works for Bedworth.—The Foleshill Rural District Council have entered into a contract with Mr. Amos Jenkins, of Nottingham, for the construction of water-works for Bedworth. His tender was £9700; the highest one being £14,114. The Council have only applied for a loan of £9640; and they have therefore decided to ask for sanction to the borrowing of an additional £1360.

New Joint-Stock Companies.—The Abingdon Acetylene Illuminating Company, Limited, has been registered with a capital of £2000, in £1 shares. The Solid Cone Incandescent Light Syndicate, Limited, has been registered with a capital of £35,000, in £1 shares, to acquire and carry into effect an agreement made between H. Hawes, R. Farrington, and W. Hand, and the Company, and generally to carry on the business of dealers in lamps, and to manufacture, import, sell, and deal in burners, glasses, shades, and appliances for incandescent and other gas lighting. Messrs. Arden Hill and Co., of Birmingham, has been formed into a company, with a capital of £20,000, in £5 shares, to take over the gas and oil stove business now carried on at Aston.

The Neutralization of Acidity in Water.—A report has lately been presented to the Water Committee of the Oldham Corporation as to the method employed at the Sheffield Water-Works and elsewhere to neutralize the acidity of the water supply. It was stated that the process could not be applied in connection with the Oldham Water-Works, and that acidity would be best prevented by not letting water stand in pools in mossy places. The Chairman (Dr. Carson) said acidity might affect the leaden pipes, and thus there might be traces of lead in the water used for domestic supply. It was important that all new pipes put in should be lined with block tin, which would obviate any detrimental results of acidity in the water. It was decided to issue notices immediately, informing plumbers that on and after the 1st of July next pipes not lined with block tin will not be permitted to be used in connection with the domestic water supply. It is understood that existing pipes will not be interfered with; but that when the time comes for their renewal, the new regulation will be operative.

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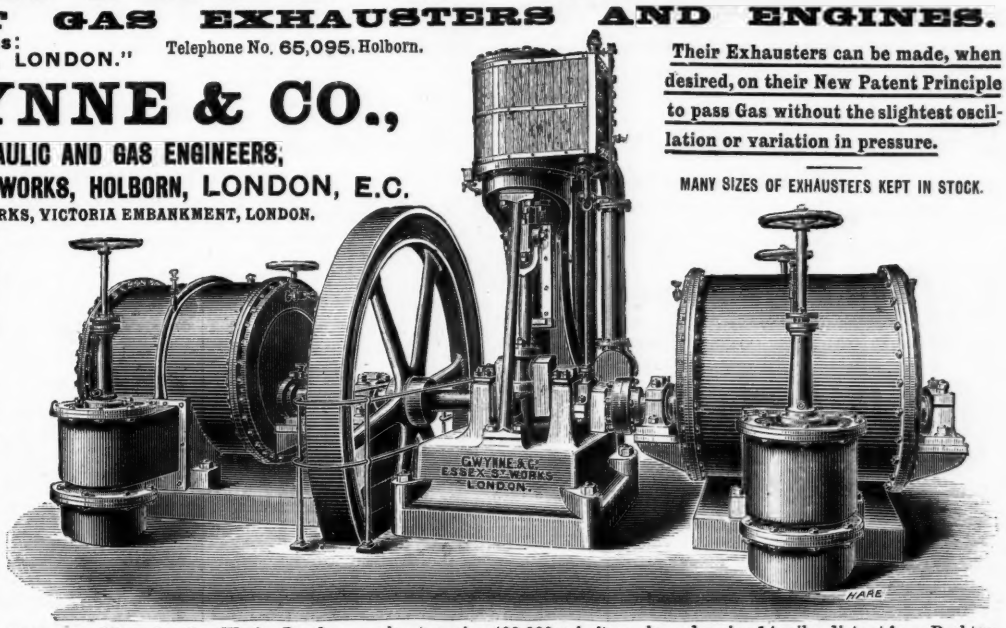
Also GIRARD and other TURBINES, HIGH SPEED ENGINES, DYNAMOS, &c., &c., for ELECTRIC LIGHTING.



Their Exhausters can be made, when desired, on their New Patent Principle to pass Gas without the slightest oscillation or variation in pressure.

MANY SIZES OF EXHAUSTERS KEPT IN STOCK.

Exhausting Machinery at Fulham and Bromley Gas-Works, London—each set passing 400,000 cub. ft. per hour drawing 14 miles distant from Beckton.

Catalogues and Testimonials sent on application.

GAS PURIFICATION AND CHEMICAL COMPANY, LIMITED.

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale in the United Kingdom than all other Oxides combined. Purity and uniformity of quality guaranteed. Pamphlet, "How to Purchase Bog Ore," to be obtained on application.

JOHN WM. O'NEILL, Managing Director, Palmerston Buildings, Old Broad Street, London, E.C.

ANDREW STEPHENSON, AGENT. All communications re Oxide to be addressed to Palmerston Buildings.

WINKELMANN'S "VOLCANIC" CEMENT. Fire Resistance up to 4500° Fahr. In use in most Continental Gas-Works, and in more than 300 British Gas-Works.

ANDREW STEPHENSON,
182, PALMERSTON BUILDINGS,
OLD BROAD STREET,
LONDON, E.C.

Telegrams: "Volcanism, London."

J. & J. BRADDOCK, Globe Meter Works, Oldham.

First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.

Telegraphic Address: "Braddock Oldham."

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Limited, Chemical Works, Leeds, specially produce this ACID from SULPHUR, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

PORTER & CO., Gowts Bridge Works, LINCOLN, Engineers, Ironfounders, and Contractors for the erection of Gas-Works for Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.

Telegraphic Address: "PORTER LINCOLN."

[For Illustrated Advertisement, see Jan. 4, p. 49.]

GAS PURIFICATION.

OXIDE OF IRON BOG ORE.

BALE & CO.'S Oxide of uniform quality. SPECIAL FIRE CEMENT, OXIDE PAINTS, OILS, SULPHURIC ACID, &c.

120 and 121, NEWGATE STREET, LONDON, E.C.

Telegrams: "BOGORE, LONDON."

TO GAS AND WATER OFFICIALS.

SPECIALLY favourable terms for Cycles. First-Class Workmanship and Material guaranteed. Art Catalogue post free.

MELROSE CYCLE COMPANY, COVENTRY.

CANNEL, COAL, ETC.

JOHN ROMANS & SON, EDINBURGH, Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS and WATER WORKS.

Prices, &c., will be forwarded on application to No. 30, ST. ANDREW SQUARE, EDINBURGH, NEWTON GRANGE, NEWBATTLE, DALKEITH, SCOTLAND.

NOTICE TO ADVERTISERS.—COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office *not later* than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or Stoppages of PERMANENT ADVERTISEMENTS, should be received not later than the FIRST POST on SATURDAY.

AMMONIACAL LIQUOR wanted.
BROTHERTON AND Co., Ammonia Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

SULPHATE OF AMMONIA SATURATORS.

WALTER THOMASON and SONS, Chemical Plumbers, &c., and Makers of Lead Saturators, &c., 21, WESTON STREET, BOLTON. Repairs of every description.
Please write for Estimate before ordering elsewhere.

HYDRATED OXIDE OF IRON.

PREPARED from pure Iron.
Two or three times as rich as Bog Ore.
Strong action on Sulphuretted Hydrogen.
To be used alone, but will increase activity of other Oxides.
Less than half the price of Bog Ore.
Can be lent on hire.
Write for tabulated results.
READ HOLLIDAY AND SONS, LIMITED, HUDDERSFIELD.

GAS TAR wanted.
BROTHERTON AND Co., Tar Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

PATENTS FOR INVENTIONS.

J. C. CHAPMAN, M.I.M.E., and Fel. Chartered Inst. Patent Agents. ADVICE ON ALL MATTERS CONNECTED WITH ABOVE.
Information and Handbook on application.
70, CHANCERY LANE, LONDON, W.C.

SULPHURIC ACID for Sale.
BROTHERTON AND Co., Chemical Manufacturers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

SULPHATE OF AMMONIA SATURATORS.

JOSEPH TAYLOR & CO., Chemical Plumbers, &c., and Makers of every description of Solid Plate Lead and Timber Cased Saturators, &c., CENTRAL PLUMBING WORKS, TOWN HALL SQUARE, BOLTON. Special attention to Repairs.
Before placing Orders, please write for Estimate.

NEW GAS PLANT CEMENT.

JOHN E. WILLIAMS AND CO.,
VICTORIA PAINT WORKS,
MANCHESTER.
For all Joints in connection with Oil-Gas Plant and Sulphate Plant.
For all Gas Joints.
For all Tar Joints.
For all Ammonia Joints.

SPENT OXIDE wanted.
BROTHERTON AND Co., Chemical Manufacturers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

SADLER & CO., Ld., Middlesbrough; ULVERSTON (BARROW); PORTSMOUTH; CARLTON (N.E.R.); and STOCKTON. Tar and Petroleum Distillers. Benzol and Petroleum Spirit, 700 and other Gravities specially prepared for Carburetting. SOLAR OIL for Gas Making, Kerosene, &c.
Correspondence invited.
Telegraphic Address: "SADLER, MIDDLESBROUGH."

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. **Compare Prices and Particulars before ordering elsewhere.**
J. F. BLAKELEY, Gas Engineer, Ravensthorpe, YORKS.

BROTHERTON & CO.
Offices: Commercial Buildings, LEEDS.
Correspondence invited.

TUBES for Gas, Steam, and Water (all Sizes) Welded or Riveted. TANKS, HYDRAULIC MAINS, RETORT-LIDS, &c.
JOHN SPENCER, Globe Tube Works, WEDNESBURY; and 14, Great St. Thomas Apostle, LONDON.

HUTCHINSON BROTHERS, Gas Engineers, &c., Falcon Works, Barnsley, Makers of Wet and Dry Gas-Meters, Brass-Work, and general Gas Apparatus, Lead Saturators, Tanks, &c., Tools, and Gas-Works Sundries. (See p. 152, last week's issue.)
Telegrams: "HUTCHINSON BROS., BARNSLEY."

IMPORTANT.

OLD Retorts made equal to new by repairing them with CROWTHER'S PATENT STICKFAST FIRE CEMENT. Unequalled for Repairing Inclines. Can be used in Hot or Cold Retorts; and "A1." for Mouthpiece Joints. Satisfaction Guaranteed.
CROWTHER, Practical Retort Setter, Manor Street, HUDDERSFIELD.

GAS CARBON Wanted, not less than 4-Ton Loads.
Apply to the BRIMINGTON CARBON COMPANY, Sowerby Bridge, YORKS.

WANTED, an appointment by an ENGINEER experienced in the design and erection of Gas-Works, and general Engineering, either on large Extensions to Works or as AGENT to a Firm of Contractors.
Address C. E., 141, Walton Street, OXFORD.

AGENCIES FOR HOLLAND.

A YOUNG Dutchman, well introduced to many Managers of Gas-Works and leading Gas-Fitters, wishes to REPRESENT first-class English Firms in Holland.
Please address H. 153, care of H. PRAKKE, Bookseller, Nymegen, HOLLAND.

SCOTSMAN, certificated in all Me- chanical subjects, good Draughtsman, and with excellent Experience in Gas Engineering Contractors' Works and large Provincial Gas-Works Practice, is willing to act as LONDON and DISTRICT REPRESENTATIVE for good Firms connected with the Gas Industry.
Address No. 2992, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Working Manager and STOKER for small Country Gas-Works. Able to do Fitting and understand Exhauster.
Apply to GEORGE RYLE, Secretary, Gas Company, Castle Donington, near DERBY.

WANTED, a competent Gas-Fitter, with experience in Main and Service laying. Permanent Situation to good steady man. Wages 28s. per week.
Applications and References to Mr. G. S. FRITH, Gas Office, FRODSHAM.

HONG KONG AND CHINA GAS COMPANY, LIMITED.

WANTED, an experienced Clerk for the Gas Office at Hong Kong.
Apply, by letter, to JOHN SPROXTON, Secretary, 148, Gresham House, LONDON, E.C.

WANTED, an experienced Main and SERVICE LAYER. One capable of Erection of all Gas-Works Plant. Permanent Engagement to a steady and competent Workman.
State (by letter) References and Wages expected to No. 2987, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a practical Working Gas MANAGER for Works in a town of 10,000 Population. Wages £2 2s. a week, with House, Light, and Fuel.
Applications, with three original Testimonials, to be sent to the undersigned on or before Monday, the 31st of January.
THOS. FALKNER ALLISON.
Louth.

COLWALL GAS COMPANY, LIMITED.

WANTED, at once, a Working Manager for small Gas-Works. Make about 2 millions. Must be a thoroughly steady, practical Man, and good at House Fitting. Wages, 25s. per week, with House, Coal, and Gas Free.
Apply, giving References and stating earliest date disengaged and duties can be commenced, to Mr. G. H. T. FOSTER, Solicitor, Secretary to the Company, MALVERN LINK.

WESTERN VALLEYS (MON.) WATER AND GAS COMPANY.

THE above Company require a competent MANAGER and SECRETARY for their Gas and Water Works.
Applicants must have had experience in Gas and Water Works, and a knowledge of, and experience in, keeping Gas and Water Accounts.
Applications stating Age, Salary required, Experience, &c., with *copies* of not more than Three recent Testimonials, to be sent to the undersigned, endorsed "Manager," not later than Tuesday, the 1st of February next.
OCTAVIUS THOMAS,
Manager and Secretary.
Gas-Works, Pontymister, Mon.,
Jan. 19, 1898.

CORPORATION OF BURY.
(GAS DEPARTMENT.)

THE Gas Committee are prepared to receive APPLICATIONS for the position of ENGINEER and GENERAL MANAGER of the Gas-Works and Tar-Plant. Annual make of Gas about 325 Million cubic feet. The Salary will commence at £350 per annum.
Applications, endorsed "Gas Manager," must be received by the undersigned, stating Age and Qualifications, not later than Monday, the 7th of February, 1898, and must be accompanied by *copies* of not more than three recent Testimonials.
A printed list of the duties may be obtained after Thursday, the 27th inst.
Canvassing members of the Corporation is strictly prohibited, and will disqualify candidates.
JOHN HASLAM,
Town Clerk.
Corporation Offices, Bury.

WANTED, a good steady Man, used to Shovel Charging, Exhauster and Engine. Wages 27s. State whether Married or Single.
Apply to the MANAGER, Gas-Works, Ware, HERTS.

CITY OF BRADFORD.

THE Gas and Electricity Supply Com- mittee invite applications for the position of ASSISTANT GAS ENGINEER, at a salary of £250 per annum.
Candidates must have had practical experience in Gas-Works Management, and must possess a good knowledge of Gas Engineering and Chemistry.
Applications, endorsed "Assistant Gas Engineer," and stating Age and Qualifications, with *copies* of not more than three recent Testimonials, to be addressed to me on or before Jan. 31 inst.
Canvassing will be considered a disqualification.
GEORGE MCGUIRE,
Town Clerk.
Town Hall, Bradford,
Jan. 11, 1898.

WANTED Carbon. State Price for 4-ton Lots, delivered at nearest Station.
Address No. 2960, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, second-hand, in good condition, ten 16-inch CIRCULAR MOUTHPIECES, with Lids, Screws, &c.
Price and Particulars to No. 2991, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, an Exhauster, in perfect order, to suit output of about 5 million feet per annum.
Price and full Particulars at once to GEORGE RYLE, Secretary, Gas Company, Castle Donington, near DERBY.

FOR SALE—Second-hand Gasholder, in good order, 24 ft. by 10 ft., three Columns, Six Guide Rails, Valves, and Outlet and Inlet Pipes complete.
BATHGATE GASLIGHT COMPANY, BATHGATE, N.B.

FOR SALE—A 20,000 cubic feet per hour DEMPSTER RECIPROCATING GAS EXHAUSTER, with Connections, complete. In very good condition.
Address No. 2978, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

GAS-PUMP for Sale, horizontal, one Steam Cylinder, 18-inch bore, and two Gas Cylinders, 17½-inch bore, all 24-inch Stroke, on massive Bed-Plate, with heavy Fly-Wheels. Very strong. First-Class Make. Not much used.
Apply, by letter, to No. 2878, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

EXHAUSTER, in perfect order, 25,000 cubic feet per hour, with two Valves and Connections, £35.
GASHOLDER and IRON TANK, 9000 cubic feet capacity, nearly new, £165 f.o.r.
Address No. 2984, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

FOR SALE — A Modern Sulphate of AMMONIA STILL, built by Messrs. R. & J. Dempster, Manchester, 1893, with separate Liming Compartment. Capacity, with ordinary Liquor, 5000 to 6000 lbs. of Sulphate per day.
For further Particulars, apply to the BRYMBO STEEL COMPANY, LIMITED, near WREXHAM.

PURIFIERS FOR SALE.

THE Montrose Gaslight Company have FOR SALE four PURIFIERS, each 12 ft. by 8 ft. by 8 ft. deep, with four 8-inch and two 10-inch Four-Way Valves and Connections, three Tiers of Sieves in each Purifier, and Lifting Gear complete. All in good condition. Sides of Covers almost new.
For further Particulars, apply to the Manager, THOS. D. HALL.

PURIFIERS, ETC., FOR SALE.

FOUR Purifiers, each 17 ft. by 12 ft. by 8 ft. 6 in. deep (all inside measure), with six Four-Way Valves and 14-inch Connections and Lifting Gear; also two 20,000 cubic feet per hour EXHAUSTERS. The foregoing are all in good order, and immediate delivery can be given.
Apply to
A. MACPHERSON,
Manager.
Gas-Works, Kirkcaldy,
Jan. 20, 1898.

FOR SALE, Cheap—The under- mentioned GAS PLANT:—

	Square. Ft. in.	Deep. Ft. in.		
2 PURIFIERS,	8 0	4 6	6-in.	Valves & Connections.
1 "	7 6	4 6	6 "	" "
2 "	5 0	4 0	4 "	" "
1 "	5 0	2 9	4 "	" "

C.I. SCRUBBER, 38ft. 6in. high, 6ft. dia., 14-in. "
CONDENSER, 4 inches diameter, Vertical Pipes.
EXHAUSTER (Gwynne's) 20,000 c.f. per hour 8-in. Valves
Apply to SAML. WHILE AND SONS, 60, QUEEN VICTORIA STREET, E.C.

THE Aylesbury Gaslight and Coke Company have FOR DISPOSAL a Set of Four PURIFIERS, 12 ft. by 12 ft., 4 ft. 6 in. deep, with Centre-Valve, 12-inch Connections and Lifting Apparatus complete. Good condition.

Particulars can be obtained from GEORGE LANE, Manager, Gas-Works, AYLESBURY.

HEXHAM GAS COMPANY.

THE Directors of the above Company are prepared to receive TENDERS for the construction of a BRICK and PUDDLE GASHOLDER TANK, 80 ft. diameter by 20 ft. deep, at their Works, Hexham.

Plans and Specifications may be seen at the Company's Office, Gas-Works, Hexham.

Tenders, endorsed "Gasholder Tank," to be forwarded to the undersigned not later than Feb. 8, 1898.

The Directors do not bind themselves to accept the lowest or any tender.

HERBERT LEES, Assoc.M.Inst.C.E.,
Engineer and Secretary.

Gas-Works, Hexham,
Jan. 22, 1898.

BOROUGH OF WIDNES.

THE Widnes Corporation are prepared to receive TENDERS for the supply of FIRE-CLAY, CLAY RETORTS, BLOCKS, and BRICKS.

Specifications and Forms of Tender may be obtained from Mr. Isaac Carr, Assoc.M.Inst.C.E., Gas-Works, Widnes.

Tenders, endorsed "Fire-Clay Goods," to be addressed to the Chairman of the Gas Committee, and delivered to the undersigned not later than the 31st inst.

The Corporation do not bind themselves to accept the lowest or any tender.

H. S. OPPENHEIM,
Town Clerk.

Town Clerk's Office, Widnes,
Jan. 19, 1898.

SALES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his AUCTIONS of STOCKS and SHARES in London, Suburban, and Provincial Gas and Water Companies are held MONTHLY, at the Mart, Tokenhouse Yard, E.C.

He also undertakes the issuing by Auction of Gas and Water Stocks and Shares under Parliamentary Powers.

Terms for issuing such Capital, and also for including Gas and Water Stocks and Shares in these periodical Sales, can be obtained on application at Mr. Alfred Richards's Offices, 18, FINSBURY CIRCUS, E.C.

By order of the Directors.

GREAT YARMOUTH WATER-WORKS COMPANY.

£2500 OF FOUR PER CENT. PERPETUAL DEBENTURE STOCK, OFFERING A THOROUGHLY HIGH-CLASS INVESTMENT.

MR. ALFRED RICHARDS will Sell the above BY AUCTION, at the Mart, E.C., on Monday, Feb. 14, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors.

CRAYS GAS COMPANY.

£3500 ORDINARY FIVE PER CENT. STOCK,
TO BE SOLD BY AUCTION BY

MR. ALFRED RICHARDS, at the Mart, E.C., on Monday, Feb. 14, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, as above.

By order of the Directors.

WHITCHURCH AND DISTRICT (HANTS) GAS COMPANY, LIMITED.

150 £10 FULLY-PAID ORDINARY SHARES.

MR. ALFRED RICHARDS will Sell the above by AUCTION, at the Mart, E.C., on Monday, Feb. 14, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, as above.

By order of Executors and other Owners.

GAS AND WATER STOCKS AND SHARES
IN THE
MAIDENHEAD GAS COMPANY, GORING AND STREATLEY GAS AND WATER COMPANY, HENFIELD GAS AND COKE COMPANY, LIMITED, AND PORTSEA ISLAND GAS COMPANY,
TO BE SOLD BY AUCTION BY

MR. ALFRED RICHARDS, at the Mart, E.C., on Monday, Feb. 14, at Two o'clock.

Particulars of the AUCTIONEER, as above.

BARNET DISTRICT GAS AND WATER COMPANY.

NOTICE is Hereby Given, that the ORDINARY HALF-YEARLY GENERAL MEETING of the Proprietors of the above Company will be held at the Albion Tavern, Aldersgate Street, in the City of London, on Friday, the 25th day of February, 1898, at Half-past Twelve o'clock in the Afternoon precisely, to receive the Report of the Directors and the Accounts for the Half Year ended the 31st day of December last, to declare a Dividend, to elect Directors and an Auditor, and to transact the General Business of the Company.

The TRANSFER BOOKS WILL BE CLOSED from the 12th to the 25th of February, both inclusive.

By order of the Board,
ALFRED LASS,
Secretary.

Offices: 30, Gracechurch Street,
London, Jan. 21, 1898.

TO ENGINEERS.

THE Corporation of Halifax are prepared to receive TENDERS for the supply and erection of the CAST-IRON and STEEL WORK required for their New Purifying-House.

Copy of Specification, Form of Tender and Print, may be obtained on application to Mr. Thos. Holgate, C.E., Gas Engineer, Halifax.

Tenders, sealed and endorsed "Purifying-House," to be delivered to the Town Clerk, Town Hall, Halifax, not later than Ten a.m. on Wednesday, the 9th of February, 1898.

The person whose Tender is accepted will be required to observe the Fair Contracts Clauses adopted by the Corporation.

The Corporation are not pledged to accept the lowest or any Tender.

ILFORD GAS COMPANY.

SOUND INVESTMENT.

BY ORDER OF THE BOARD OF DIRECTORS OF THE ILFORD GASLIGHT AND COKE COMPANY, LIMITED,

MR. ASHMOLE will Sell by Auction at the Mart, Tokenhouse Yard, E.C., on Thursday, Feb. 3, 1898, at One for Two o'clock, 500 "B" SHARES, of the nominal value of £5 each, in the above old-established and flourishing Company.

Particulars and Conditions of Sale may be obtained of the SECRETARY of the Company, or of WM. ASHMOLE, F.A.I., Auctioneer, Surveyor, and Estate Agent, Broadway, ILFORD.

THE GASLIGHT AND COKE COMPANY.

NOTICE is Hereby Given, that a HALF-YEARLY ORDINARY GENERAL MEETING of the Proprietors of this Company will be held at this Office, on Friday, the 4th day of February next, at Twelve o'clock (noon) precisely, to transact the usual Business, including the declaration of a Dividend for the Half Year ending on the 31st day of December last, and to elect Directors and Auditors in the place of those who will at such Meeting go out of office in compliance with the Company's Acts or Schemes of Amalgamation.

Notice is Hereby also Given, that at such Meeting the Directors will apply to the Proprietors for AUTHORITY TO DISPOSE of such further PORTIONS OF THE COMPANY'S PROPERTY as are not now required for the purposes of their Undertaking.

Notice is Hereby further Given that, pursuant to the Standing Orders of both Houses of Parliament, an EXTRAORDINARY GENERAL MEETING of the said Proprietors will be held at the same Office immediately after the said Half-Yearly Ordinary General Meeting, when a Bill to be introduced into Parliament intituled "A Bill to Consolidate and Convert the Capital of The Gaslight and Coke Company, and for other Purposes," will be submitted to the Proprietors then present, either in person or by proxy, for their approval.

By order,
JOHN WILLIAM FIELD,
Secretary and General Manager.

Chief Office: Horseferry Road,
Westminster, S.W., Jan. 18, 1898.

SOUTH METROPOLITAN GAS COMPANY.

NOTICE is Hereby Given, that the ORDINARY HALF-YEARLY GENERAL MEETING of the Proprietors of this Company will be held at the Bridge House Hotel, London Bridge, in the Borough of Southwark, on Wednesday, the 16th day of February next, at Two o'clock in the afternoon precisely, to receive the Directors' Report and the Accounts of the Company for the Half Year ended the 31st of December last, to declare a Dividend for the same period, and to elect two Directors and one Auditor in the place of those retiring by rotation.

Notice is Hereby Given, that the Directors will, pursuant to the Scheme of Amalgamation, 1884, SUBMIT A RESOLUTION to the Proprietors, for the purpose of AUTHORIZING THE SALE OF CERTAIN LANDS which are no longer required for the purposes of the Undertaking.

The TRANSFER BOOKS WILL BE CLOSED from the 2nd day of February next until after the Meeting.

By order,
FRANK BUSH,
Secretary.

Offices: 709A, Old Kent Road, S.E.,
Jan. 22, 1898.

ALEXANDER CAMERON,

GAS AND CANNEL COAL MERCHANT,

48, WEST REGENT STREET,

GLASGOW.

E. ASQUITH & CO.,

Hydraulic Engineers,

17, Mather Street, Ancoats, Manchester,

Fit up Plants for

Pressing Anthracene, Naphthalene, &c.

Competent Men sent out to erect same. Estimates given.

THE

"ETNA" FIRE & HEAT RESISTING

CEMENT,

For RETORT PURPOSES, is INVALUABLE.

Sole Manufacturers:

FRED VERITY & SON,

CALL LANE, LEEDS.

Scores of Testimonials received. Write for Particulars.

Price, Bound in Cloth, 5s. 6d., Post Free.

— FIFTEENTH YEAR —

THE

COMPLETE REPORTS

OF

PROCEEDINGS

OF THE

DISTRICT ASSOCIATIONS

OF

GAS ENGINEERS & MANAGERS

OF THE UNITED KINGDOM

FOR 1897.

The Fourteen previous Volumes are still on Sale.

LONDON:
WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

Ready this Day—450 Pages, Crown 8vo., with numerous Illustrations, 10s. 6d. Leather.

THE

GAS ENGINEER'S POCKET BOOK,

Comprising Tables, Notes, and Memoranda relating to the Manufacture, Distribution, and Use of Coal Gas, and the Construction of Gas-Works.

By HENRY O'CONNOR, Assoc.M.Inst.C.E.

London: CROSBY LOCKWOOD & SON,
7, STATIONERS' HALL COURT, E.C.

HEBBURN MAIN GAS COALS.

Yield of Gas per ton	**10,500 cub. ft.**
Illuminating Power	**16·4 candles.**
Coke	**68 per cent.**

For Prices, f.o.b. Ship or Delivered by Rail, apply to

THE WALLSEND & HEBBURN COAL COMPANY, LTD.

8 Lombard Street,
NEWCASTLE-ON-TYNE.

W. RICHARDSON, Fitter.

GAS PURIFICATION BY HYDRATED OXIDE.

THIS Material is of full Strength, and Exceptiona Activity. It is specially prepared to minimize Back-Pressure; and will be supplied on Hire, or Sold on the most favourable Terms.

SPENT OXIDES containing Blue, also CRUDE FERRO-CYANIDE PRODUCTS, either PURCHASED or EXCHANGED for FRESH OXIDE.

MANCHESTER OXIDE COMPANY, LTD.,
CANAL ST., MILES PLATTING, MANCHESTER.

Telephone: Castleford No. 214. | **Postal Address: Castleford.**

Telegrams: "Silkstone Castleford."

THE SILKSTONE & HAIGH MOOR COLLIERIES, LTD.

ALLERTON BYWATER, CASTLEFORD.

Steam, Manufacturing, & Gas Coals & Cannel.

Analysis, Contracts, Trial Waggons, and Quotations for Large and Small Orders. Inquiries Solicited.

HEATHCOTE GAS COAL.

Rich in Illuminating Power and Yield of Gas. Above the Average in Weight and Quality of Coke.

Maintains a High Standard in Residuals.

THE GRASSMOOR CO., LD.

CHESTERFIELD.

TROTTER, HAINES, & CORBETT,
Brettell's Estate
FIRE-CLAY & BRICK WORKS,
STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY.
Shipments Promptly and Carefully Executed.

London Office: R. Cull, 84, Old Broad St., E.C.

ROBERT MARSHALL,
CANNEL COAL MERCHANT,
97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on Application.

NEWBATTLE CANNEL.
Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO
THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

THE SILICA FIRE-BRICK COMPANY,
OUGHTIBRIDGE, near SHEFFIELD,
MANUFACTURE
SILICA BLOCKS, BRICKS, AND CEMENT
OF SUPERIOR QUALITY
FOR GAS-FURNACES.
Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their
GREATER DURABILITY,
Strongly recommended where EXCESSIVE HEATS have to be maintained.

HOLMSIDE
GAS COALS.
Present Daily Produce over 5000 Tons.

Latest Analysis—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation

Yield of Gas per Ton . . . 11,205 Cubic Feet.
Illuminating Power 16 7/10 Stand. Sperm. Candl.
Coke (of good & pure quality) 13¾ Cwt. per Ton.
Sulphur . . . . . A little over 1 per Cent.
Ash . . . . . Under 1 per Cent.
Tar . . . . . 163 lbs. (Avoir.) per Ton.
Ammoniacal Liquor 103 lbs. (Avoir.) per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England, and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR
PELTON GAS COALS.
Present Daily Produce available 3000 Tons.

Of equal quality to the "Holmside" Coal, and also very largely used by many Gas Companies at Home and Abroad.

Both descriptions are shipped at Tyne Docks, and Dunston Staiths, River Tyne, also at North and South Docks, Sunderland.

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,
HOLMSIDE & SOUTH MOOR OFFICES,
NEWCASTLE-UPON-TYNE.

EVESON FOR CANNEL

Telegrams:
"EVESON, BIRMINGHAM."

PRICE'S COKE & COAL BARROW

effects a great saving of time, labour, and expense.
For Particulars, Price, &c., apply to Mr. Edward Price, 119, Queen's Road, Finsbury Park, N.
Prices are Reduced.

UNEQUALLED.
Gas Companies are solicited to try Samples of the
MIRFIELD
BLACK BED GAS COAL.
Prices and Analysis on application.
MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

THORNLEY GAS COALS
WORKED BY THE
WEARDALE IRON & COAL Co., Ld.
OUT OF THEIR
THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by
Messrs. J. & H. S. PATTINSON, *May 28, 1895.*

Yield of Gas per Ton . .	10,500 Cub. Ft.
Illuminating Power . .	16·9 Candles.
Coke (of good quality) . .	67·5 per Cent.
Sulphur	0·58 „
Ash	2·73 „

For Price, &c., apply to the
WEARDALE IRON & COAL Co., Ld.
QUAYSIDE, NEWCASTLE-ON-TYNE.

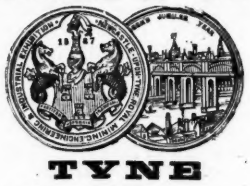
INCANDESCENT GAS LIGHTING
Has now gained a complete and final Victory over its last and greatest Enemy
VIBRATION,
BY MEANS OF
CLAY'S PATENT
SHOCK-PROOF
Incandescent Burner Fittings
Of which full Particulars may be had from
CLAY & WALMSLEY,
BOLTON, ENGLAND.
Telegrams: "CLAYS, BOLTON."
See "Journal of Gas Lighting," July 7, 1896, p. 19, and Dec. 21, 1897, p. 1365.

London Representatives: Messrs. Henry Greene & Sons, 153 & 155, Cannon Street, E.C.

Lanemark Coal Co.,
LIMITED.
LANEMARK CANNEL AND GAS COALS.
Quotations and Analysis on Application to
LANEMARK COLLIERY,
NEW CUMNOCK, N.B.
Shipping Ports: All the principal Scotch Ports.

THOMAS TURTON AND SONS, LIMITED,
SHEAF WORKS, SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES, SPANNERS, RATCHET BRACES, LIFTING JACKS, ANVILS, VICES, AND ENGINEERS' TOOLS GENERALLY.
London Office:
90, CANNON STREET, E.C.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for
CANNEL & COAL.



TYNE BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub.
Illuminating Power	17·8 candles.
Coke	70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	73·1 per cent.

For Prices and complete Analysis, apply to
THOS. W. DANCE & SONS,
Coal Owners, Newcastle-on-Tyne;
OR
E. FOSTER & CO.,
21 John Street, Adelphi, London, W.C

BOLDON GAS COALS.

ANALYSIS.

Yield of Gas per ton . .	10,500	Cubic Feet.
Illuminating Power . .	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

For Prices, &c., apply to

W. H. PARKINSON,
THE HARTON COAL CO., LTD.,
NEWCASTLE-ON-TYNE.

Telegraphic Address: "PARKINSON NEWCASTLE."

JAMES OAKES & Co.,

ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road, CITY ROAD, LONDON, N.,

Manufacture and keep in Stock at their Works (also large stock in London)

PIPES and CONNECTIONS, 1¼ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaple's; doing away with bolts, nuts and covers, and rendering leakage impossible.

LONDONDERRY GAS COALS

FROM THE

MARQUIS OF LONDONDERRY'S COLLIERIES,

COUNTY OF DURHAM.

Available output up to 5000 tons per day.
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by Mr. John Pattinson, F.C.S., F.I.S.

FOR PRICES AND PARTICULARS, APPLY TO

S. J. DITCHFIELD,
SEAHAM HARBOUR, COUNTY OF DURHAM.

H. KIRKHAM & CO.

Are now prepared to Tender for **SCRUBBER-WASHERS** fitted with their Patent Basket or Cage, with Improved Washing Surface. It is acknowledged to be the **MOST EFFECTIVE MACHINE** for extracting Ammonia and other Impurities from Coal Gas. It is guaranteed to Purify 20 per cent. more Gas in the same space, and at considerably less cost per Machine. The Baskets and Scrubbing Surface can be readily applied to all the sizes of the Kirkham, Hulett, and Chandler Machines now in use.

Office: 335, MANSION HOUSE CHAMBERS, LONDON, E.C.

G. & J. HAIGH,

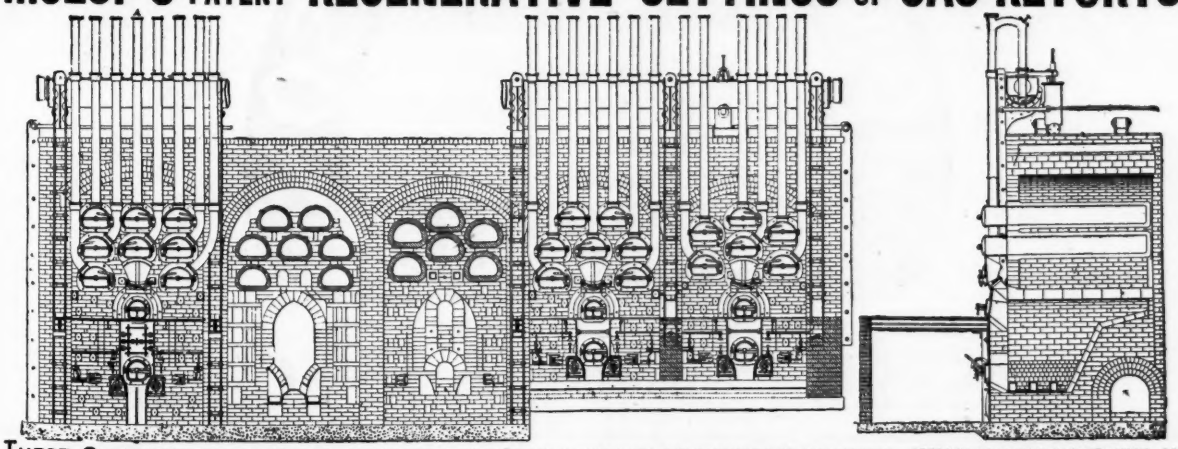
Raven's Lodge Fire-Brick Works, DEWSBURY.

FIRE-BRICKS of the highest Quality, made from Fire-Clay of a most Superior and Refractory Character, suitable for **GLASS-WORKS, GAS-WORKS, and BLAST-FURNACES.**

WHITE GLAZED AND SALT GLAZED BRICKS, BUFF FACING BRICKS, &c.

For Prices and Analysis, apply as above.

HISLOP'S PATENT REGENERATIVE SETTINGS OF GAS-RETORTS.



THESE SETTINGS ARE POSITIVELY UNRIVALLED IN PRODUCTIVE CAPACITY, DURABILITY, AND SIMPLICITY OF MANAGEMENT RETORTS OF ORDINARY DIMENSIONS CARBONIZING FROM 17 TO 20 CWT. OF ENGLISH AND 20 TO 24 CWT. OF SCOTCH COAL PER 24 HOURS, DEPENDING UPON THE NATURE OF THE COAL, AND PRODUCING UP TO FULLY 13,000 CUBIC FEET PER MOUTHPIECE IN THE SAME TIME, AND WITH THE SMALLEST EXPENDITURE OF FUEL ATTAINABLE, AND RETURNING IN PROFIT THE ENTIRE COST OF ERECTION WITHIN TWELVE TO EIGHTEEN MONTHS; AND THUS REDUCING TO INSIGNIFICANCE THE INCREASED COST OF THESE SETTINGS OVER THE COMMON OR GENERATOR FURNACE SYSTEMS.

THESE SETTINGS ARE EXTENSIVELY ADOPTED, AND ARE ERECTED UPON THE SHALLOW AND STAGE FLOOR PLANS. THEY ARE ADAPTED TO ANY EXISTING ARRANGEMENTS, AND PERFECT SATISFACTION GUARANTEED. THE COMPOSITION OF FIRE-RESISTING AND OTHER SPECIAL FIRE-CLAY MATERIALS FURNISHED IS OF THE HIGHEST ORDER; AND THE SYSTEM AS A WHOLE, AS NOW PERFECTED, IS THE RESULT OF LONG EXPERIENCE AND CAREFUL STUDY OF THE PRINCIPLES OF GASEOUS FIRING.

Drawings and Tenders are furnished for the complete erection of Benches, including Retort and Bench Mounting of the most modern and approved description; or existing Ovens fitted up with the Patentee's arrangements.

Agents: **Messrs. JONAS DRAKE AND SON**, Retort Setters and General Carbonizing Engineers, Ovenden, Halifax, Yorkshire, Sole Agents for England, Wales, and Foreign Countries; **C. M. HAMILTON**, Retort Setter and Contractor, Hamilton, Agent for Scotland and Ireland. Principal Agent: **R. F. HISLOP** (Son of Patentee), General Constructing and Carbonizing Engineer, Gas-Works, Paisley, N.B., to whom all Inquiries should be addressed in the first instance.

HISLOP'S PATENT HYDRAULIC MAIN SEAL-REGULATING AND TAR-EXTRACTING VALVE is a *Sine qua non*

TO THE SATISFACTORY WORKING OF THE HYDRAULIC MAIN UNDER THE REGENERATIVE AS WELL AS OTHER SYSTEMS OF RETORTS. BEING LARGELY ADOPTED AND AFFORDING THE HIGHEST SATISFACTION.

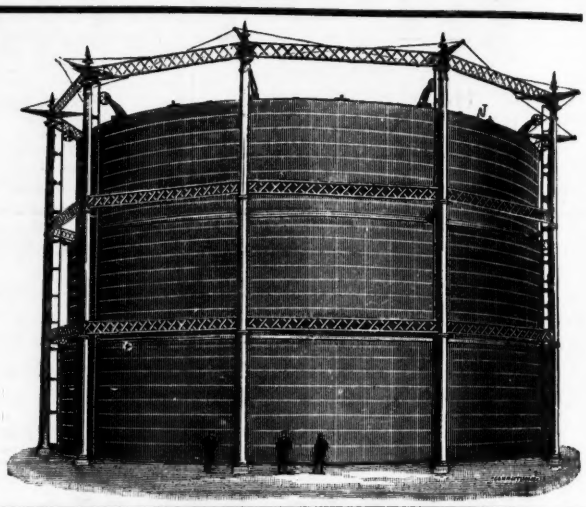
The Patentee's SELF-SEALING CAPS FOR THE TOP OF ASCENSION-PIPES, and his "SPECIAL" FLUE PORT BOXES, are most important additions to his Carbonizing Plant.

SPENT LIMES NO LONGER WASTE PRODUCTS.

Under G. R. HISLOP'S Patents, all Spent Limes are effectively recovered at from one-third to one-half the cost of New Lime.
Further Information and Pamphlets from Principal Agent.

HARRIS & PEARSON,
STOURBRIDGE, ENGLAND
MANUFACTURERS OF
FIRE-CLAY GAS-RETORTS, FIRE-BRICKS, LUMPS, & TILES of Every Description.
GLAZED BRICKS AND PORCELAIN BATHS.

HANNA, DONALD, & WILSON,
(Established 1851),
GAS ENGINEERS & CONTRACTORS,
Abercorn Foundry and Abbey Works,
PAISLEY, N.B.,
MAKERS OF
Gasholders and Gas Plant
OF EVERY DESCRIPTION.
Sole Agents for Scotland for the Automatic Coal-Gas Retort (Inclined System) Company, Limited.
Telegraphic Address: "Donald, Paisley."



LONDON OFFICE
60, QUEEN VICTORIA ST. E.C.
TELEGRAPHIC ADDRESSES
"DRAKESON HALIFAX."
"ECLAIRAGE LONDON."
TELEPHONE No. 43.
"HALIFAX EXCHANGE"
GAS ENGINEERS.
CONTRACTORS.
IRONFOUNDERS.
JONAS DRAKE & SON
SOLE AGENTS FOR
HISLOP'S
PATENT REGENERATIVE FURNACES
—FOR—
ENGLAND, WALES & ABROAD.
RETORT BENCHES ERECTED COMPLETE
WITH OR WITHOUT SPECIAL FURNACES.
RESULTS GUARANTEED.
OVENDEN HALIFAX
RETORT SETTERS.
FURNACE BUILDERS.
ETC. ETC.
Designs and Estimates on Application.
GASEOUS FIRING A SPECIALTY.

MOBBERLEY & PERRY
STOURBRIDGE.
Manufacture & supply best quality of
Gas Retorts (SEGMENTAL, HORIZONTAL, or INCLINED.)
Special Bricks & Blocks for GENERATOR & REGENERATOR FURNACES.
FIRE BRICKS, LUMPS, & TILES, BLUE STAFFORDSHIRE VITRIFIED BRICKS FOR PAVING, &c. &c.
EVERY REQUISITE FOR GAS-WORKS. Retort Setters sent to any part of the Kingdom.
London Agents: Contractors for the erection of Retort-Benches complete.
BALE & HARDY, Gas Engineers and Contractors,
BRIDGE HOUSE, 181, QUEEN VICTORIA STREET, E.C.

WOMBWELL MAIN COMPANY, LD.,

BARNSLEY.

BEST GAS COAL.

ANALYSIS: 11,390 feet of 17-Candle Gas. Value in Sperm per ton, 686 lbs.

By R. O. PATERSON, C.E.

APPLY

WOMBWELL MAIN COMPANY, LIMITED, BARNSLEY.

Telegrams: "MAIN, WOMBWELL."

STOCKPORT GASHOLDER

ON PEASE'S STEEL CABLE SYSTEM.

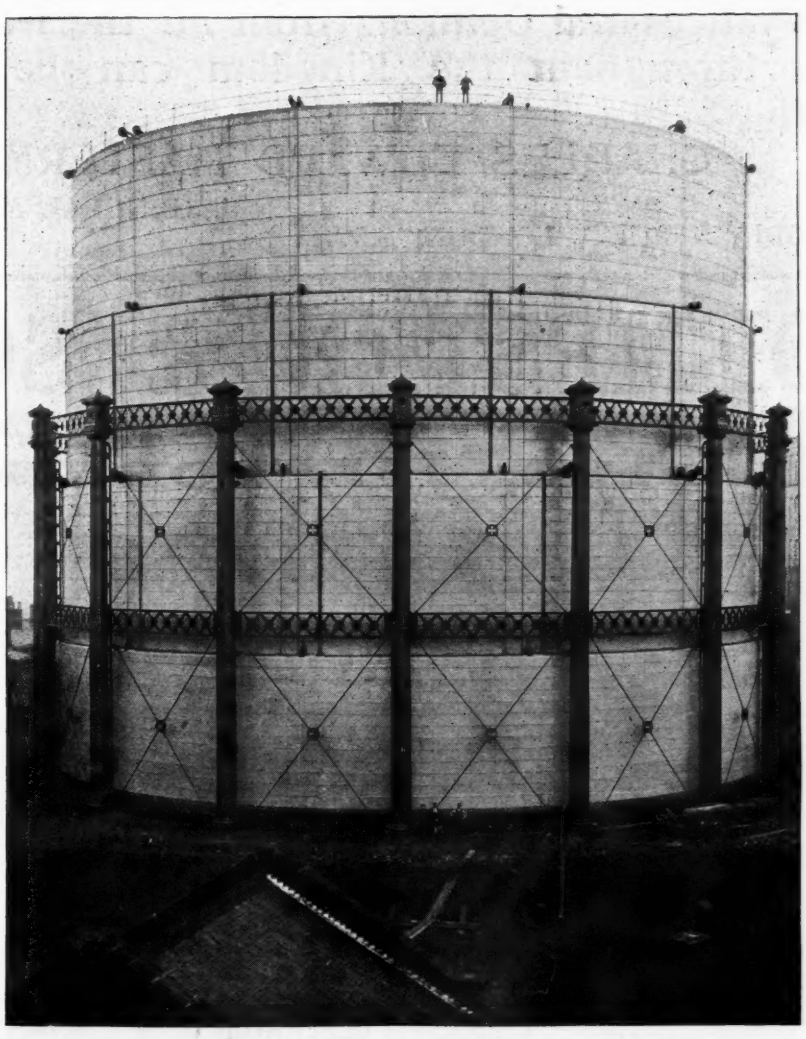
Great Saving in Cost, and Absolutely Reliable in Working.

TIME SAVED IN ERECTION.

WEIGHT SAVED.

FREIGHTS REDUCED.

INSPECTION INVITED.



THESE HOLDERS ARE CERTIFIED BY USERS TO BE STEADIER UNDER WIND PRESSURE THAN HOLDERS WITH COLUMNS.

INSPECTION INVITED.

TWO LIFTS ADDED WITH PATENT CABLE GUIDING (PEASE'S SYSTEM).
Enlarged under Patent 41,189, 1897, with Water in the Tank, for STOCKPORT CORPORATION.

Manufacturers and Patentees, (*From a Photograph.*) Telegrams: "GASHOLDER."

ASHMORE, BENSON, PEASE, & CO., LIMITED,

STOCKTON-ON-TEES.

THE

DENAYROUZE LIGHT SYNDICATE, LTD.,

BEG to announce that, having made arrangements for the Manufacture of their **BURNERS** in England, they are **NOW ABLE TO SUPPLY THESE IN ANY QUANTITY.**

These Burners (with Mantles specially made for the Syndicate by the Incandescent Gas-Light Company, Ltd., under the Welsbach Patents) are admitted by all Experts to be the **BEST AND MOST ECONOMICAL LIGHTS FOR LARGE AREAS AND PUBLIC STREETS.**

Press Notices and Opinions from all the leading Gas Managers throughout the Kingdom can be seen on applying to

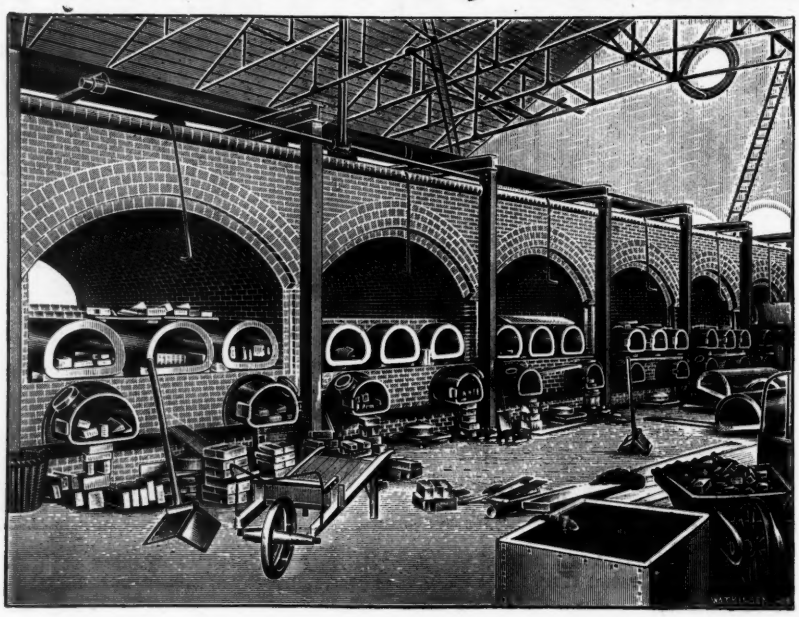
CHARLES EDWARD MASTERMAN,
GENERAL MANAGER.

28, VICTORIA STREET, LONDON, S.W.

R. DEMPSTER & SONS,
LIMITED.

ELLAND, YORKS.

DIRECT-FIRED GENERATOR AND REGENERATOR SETTINGS AND RETORT WORK IN ALL ITS BRANCHES.



REGENERATIVE SETTINGS DURING CONSTRUCTION (From a Photo.).

CONTRACTORS FOR COMPLETE INSTALLATIONS ON HORIZONTAL OR INCLINED SYSTEMS, WITHOUT SUB-CONTRACTING.

S. CUTLER AND SONS, MILLWALL, LONDON.

CARBURETTED WATER-GAS PLANT.

(CUTLER'S PATENTS)

ADOPTED AT HORNSEY, HASTINGS, SOUTHEND,
PLYMOUTH, BUENOS AYRES, SOUTHALL (BRENTFORD GAS COMPANY).
SOUTHEND—SECOND CONTRACT.

GASHOLDERS

OF EVERY SIZE AND DESCRIPTION.

CUTLER'S PATENT GUIDE-FRAMING FOR GASHOLDERS

HAS BEEN ADOPTED FOR MANY IMPORTANT HOLDERS.

IT IS STRONG AND CHEAP, AND REQUIRES NO PIERS FOR ITS SUPPORT.

R. LAIDLAW & SON

GAS & WATER ENGINEERS.

MANUFACTURERS OF WET & DRY GAS-METERS,
SIEMENS WATER-METERS,
PREPAYMENT GAS-METERS.

—DRY METER.—

—WET METER.—

EDINBURGH: SIMON SQUARE WORKS. | GLASGOW: ALLIANCE FOUNDRY. | LONDON: 6, LITTLE BUSH LANE.

BOWENS' Ltd. Successors,
STOURBRIDGE.

MANUFACTURERS OF
BEST FIRE-BRICKS; INCLINED, HORIZONTAL, and SECTIONAL RETORTS; LUMPS, TILES, &c., of every description.

Established 1860.

PETTIGREW'S PATENT

Sulphate of Ammonia Plant
ON THE CONTINUOUS SYSTEM

Is the newest in the Market, and is the outcome of practical experience in Sulphate Making.

Old Systems easily and cheaply converted.
ANY SIZE ERECTED COMPLETE AT HOME OR ABROAD.
Makers of Self-Emptying Saturators.

Write for Particulars, Testimonials, and References to

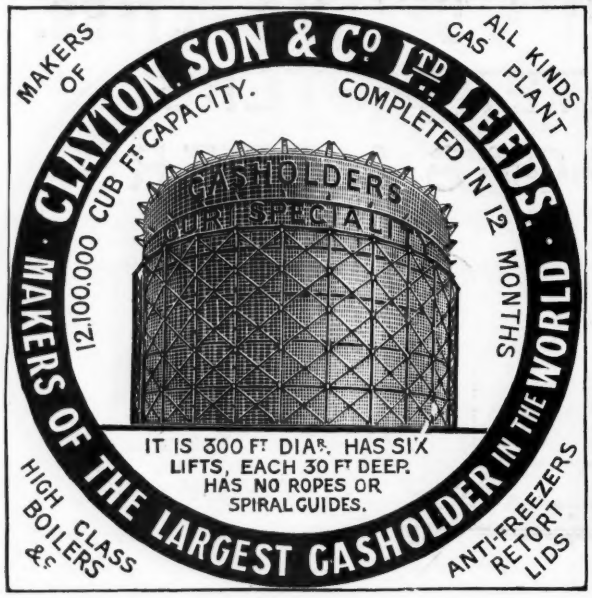
GEO. PETTIGREW & Co.,
GAS AND CHEMICAL ENGINEERS,
MIDDLESBROUGH-ON-TEES.

ARROL-FOULIS
Patent Automatic Machinery
FOR
DRAWING AND CHARGING GAS-RETORTS.

Full Particulars may be obtained from the Sole Makers,

SIR WILLIAM ARROL & CO., Limited,
GLASGOW.

[See Illustrated Advertisement, Jan. 4, p. 11.]


MAKERS OF
CLAYTON, SON & Co LTD LEEDS
ALL KINDS GAS PLANT
12,100,000 CUB FT CAPACITY.
COMPLETED IN 12 MONTHS
GASHOLDERS
SPECIALITY
IT IS 300 FT DIAR. HAS SIX LIFTS, EACH 30 FT DEEP. HAS NO ROPES OR SPIRAL GUIDES.
MAKERS OF THE LARGEST GASHOLDER IN THE WORLD
HIGH CLASS BOILERS &c
ANTI-FREEZERS RETORT LIDS

GIRDERS, ROOFS, & ALL KINDS OF STRUCTURAL IRONWORK.

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Telegraphic Addresses: "GAS, LEEDS," "ECLARAGE, LONDON."

WILSON CARTER & PEARSON,
GAS COAL AND CANNEL FACTORS,
Supply to any Railway Station, or for Export, all kinds of Fuel for Gas purposes.

ADDRESS CHIEF OFFICES:
Temple Buildings, 50, New Street, Birmingham.

WILLIAM INGHAM & SONS,
Incorporated with the Leeds Fire-Clay Company, Ltd.,
WORTLEY FIRE-CLAY WORKS,
Near LEEDS,

Have confidence in drawing the special attention of GAS ENGINEERS to the following advantages of their Retorts:—
1. Smooth interior, preventing adhesion of Carbon.
2. They can be made in one piece up to 10 feet long.
3. Uniformity in thickness, ensuring equal Expansion and Contraction.

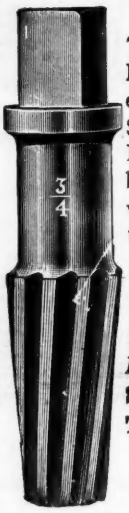
PATENT
MACHINE-MADE GAS-RETORTS.

The Climax of Regenerative Gas Lighting!!

THE
"VERTMARCHE"
A 280-Candle Power PLAIN IRON LAMP,
CLASS A— 55/-
LIGHT for LIGHT
less than half the price of any other Regenerative Lamp.
Manufactured in England.

HENRY GREENE & SONS,
153 & 155, CANNON STREET, LONDON BRIDGE, E.C.
PARTICULARS AND PRICES FREE. AGENTS WANTED.

PATENT TWISTED TAPER RYMERS & TAPS.



These **Patent Twisted Taper Rymers and Taps** are the best ever made for Gas and Water Service Connections. A true Hole and a correct Thread can be assured. They are easy to work, and will last much longer than straight grooved Taps and Rymers.

THOUSANDS ARE IN DAILY USE.

Also SCREWING-MACHINES, STOCKS and DIES (with Patent Twisted Dies), PIPE-TONGS, and other TOOLS.

Apply for Prices and Particulars to

JOHN RUSCOE,
ALBION WORKS, HYDE, near MANCHESTER.

HARPER & MOORES,
STOURBRIDGE.

MANUFACTURERS OF
BEST FIRE-BRICKS, GAS-RETORTS,
LUMPS, TILES, AND ALL ARTICLES IN FIRE-CLAY.
Proprietors of Best Glasshouse Pot, Crucible, and other Stourbridge Clays.
MANUFACTURERS OF GLASSHOUSE POTS AND CRUCIBLES OF EVERY KIND.
ESTABLISHED 1826.

JOSEPH CLIFF & SONS,
INCORPORATED IN
THE LEEDS FIRE-CLAY COMPANY, Ltd.
WORTLEY, LEEDS.

LONDON OFFICES & DEPÔTS:
Baltic Wharf, Waterloo Bridge.
WHARVES NOS. 2 & 4, INSIDE G.N. GOODS YARD, KING'S CROSS, N.
LIVERPOOL:
16, Lightbody Street.
LEEDS:
Queen Street.

MACHINE-MADE RETORTS

Have been made in large quantities for the last twelve years; and during the whole of that time, have been in regular use at most of the largest Gas-Works in the Kingdom. They possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.

RETORTS CAREFULLY PACKED FOR EXPORT.
Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

GODDARD, MASSEY, & WARNER'S
IMPROVED
Sulphate of Ammonia Apparatus.

The most successful and approved Apparatus known up to the present time.

FOR REFERENCES, PARTICULARS, TESTIMONIALS, AND PRICES APPLY TO

GODDARD, MASSEY, & WARNER,
ENGINEERS,
NOTTINGHAM.

The Apparatus has been supplied to the following Firms—

BURT BOULTON, & HAYWOOD, SILVERTOWN, and ELING.
CHANCE BROTHERS, OLDBURY (Four Apparatus).
RUNCORN SOAP & ALKALI CO., Limited, RUNCORN.
NETHAM CHEMICAL CO., Limited, BRISTOL.
ANIMAL CHARCOAL CO., Limited SHADWELL.
WM. BUTLER & CO., BRISTOL.
KEMPSON & CO., Pye Bridge.

And to the following Gas Companies and Corporations—

ILKESTON.	BURY.	CHORLEY.
WIDNES.	BRIGHOUSE.	WHITEHAVEN.
HALIFAX.	MARKET HARBRO'	CHESTER.
ALTRINCHAM.	PRESCOT.	SOUTH SHIELDS.
DENTON.	SOWERBY BRIDGE.	LEEK.
ST. ALBANS.	LEICESTER.	IPSWICH.
DUKINFIELD.	DARWEN.	BOURNEMOUTH.
NORTHWICH.	NELSON.	SALFORD.
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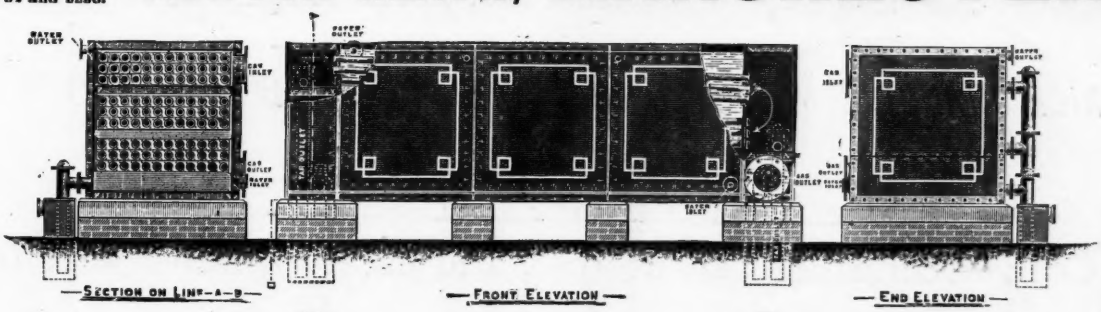
		HAMPTON COURT.

R. & J. DEMPSTER, LTD., GAS PLANT WORKS,

Telegraphic Address:
"SCRUBBER, MANCHESTER."
National Telephone Nos. 54 and 2296.

NEWTON HEATH, MANCHESTER.



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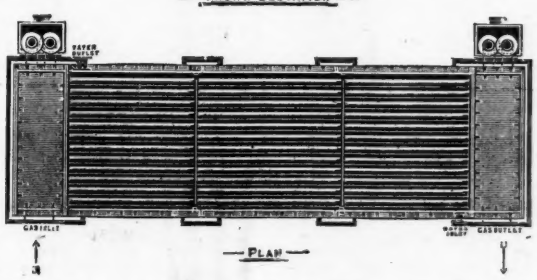
SLOW-SPEED,
UNIFORM,
EFFECTIVE.



IN DESIGN.
SIMPLE,
DURABLE,
INEXPENSIVE.

WATER-COOLED GAS-CONDENSERS.

R. & J. D., Ltd., have at present in hand, for at Home and the Colonies, Water Condensers equal to **7,250,000** cubic feet per day.

Particulars, Prices, and Testimonials on Application.

PARKINSON'S
PREPAYMENT GAS-METERS.

Many Thousands in use in all parts of the Country.

COMBINE SIMPLICITY WITH STRENGTH.

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